A. B. FILSON YOUNG

THE COMPLETE MOTORIST

WORKS BY THE SAME AUTHOR

THE RELIEF OF MAFEKING

MASTERSINGERS

IRELAND AT THE CROSS ROADS

THE
COMPLETE MOTORIST

BEING AN ACCOUNT OF THE EVOLUTION AND CONSTRUCTION OF THE MODERN MOTOR-CAR; WITH NOTES ON THE SELECTION, USE, AND MAINTENANCE OF THE SAME; AND ON THE PLEASURES OF TRAVEL UPON THE PUBLIC ROADS

BY

A. B. FILSON YOUNG

"THE CHARIOTS SHALL RAGE IN THE STREETS, THEY SHALL JUSTLE ONE AGAINST ANOTHER IN THE BROAD WAYS: THEY SHALL SEEM LIKE TORCHES, THEY SHALL RUN LIKE THE LIGHTNINGS."

The Prophet Nahum

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TO

WALTER VICTOR STUART

IN REMEMBRANCE OF

EARLY ADVENTURES WITH MACHINES

AND OF

TOILS AND PLEASURES SHARED

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PREFACE

THE rapid progress of the industry and pastime of motoring, with which its literature has hardly kept pace, must be the excuse for a new book on motor-cars. Mr. Worby Beaumont's valuable work will probably always remain a standard book of reference for designers; Mr. Rhys Jenkins's *Motor Cars* is a classic on the history of mechanical traction, by which no writer who follows him can fail to benefit; while the Badminton volume on *Motors and Motor Driving*, by virtue of its fulness of detail and the personality of its writers, many of whom are identified with the motor movement as founders and pioneers, has an authority and historical value to which the work of no single writer can lay claim. There are also several smaller works dealing with various aspects of the subject which are, within their respective limits, of great interest and importance; but so far as I am aware, no amateur of automobilism has hitherto attempted to deal single-handed with the whole subject—historical, technical, critical, practical, human, and sentimental. That this is an ambitious and difficult task no one is better aware than I, but the absence or reluctance of better-qualified men is my excuse for making the attempt. I have tried to write the kind of book that I myself wanted to read when I first became interested in motoring, but that did not exist then, and I fear, in spite of my efforts, does not exist now. I am sorry that limitations of space made it impossible for me to include chapters on marine motors and motor cycling; but the fact that these interests, large as they are, are to some extent separate from ordinary motoring, made me decide to

omit them altogether rather than deal with them briefly and inadequately.

In the technical parts of the book I have been confronted with the danger either of being too technical for the uninformed or too elementary for those who have some mechanical knowledge. But in these days, when crank shafts and inlet valves, coils and radiators, figure in the common talk of club-rooms, I have thought it safe in my descriptions of various cars and systems to take for granted at least an elementary knowledge of mechanics on the part of my readers, and to descend to the A B C only in the description of the petrol engine and its parts. Professional engineers will, I hope, be tolerant of technical shortcomings, and remember that these pages are written by an amateur for amateurs, and that the point of view throughout is that of the private user of motor-cars.

If this book were three times as large as it is, it would still (to adopt an Irish idiom) be "full of omissions," and these will readily be detected by the people interested in the things omitted. As there are at least a hundred more or less reputable makes of motor-car on the market, any selection of a dozen of them for description and illustration must be an arbitrary selection. In making my choice I have been influenced solely by the desire to interest and inform the readers of this book. Such cars as the Crossley, the Hutton, and the S.-M., which have, of course, not yet earned any public reputation, are described because they are new, and because they mark an advance in motor-car engineering. In other cases I have, for the most part, chosen cars which have been well tried by the public and have long passed the experimental stage. Naturally I have made as large a selection as possible from among English-built cars, but in no case is the mere inclusion or exclusion of any particular car to be regarded as a criticism of its merits.

My thanks are due to M. Paul Gervais for leave to reproduce his charming picture "L'Effroi"; to the editor of the Autocar

for assistance in various matters most readily given, and for the use of blocks and tables; to the editor of the *Automotor Journal* for the use of blocks; to Mr. Julian Orde, Secretary of the Automobile Club of Great Britain and Ireland, for his unfailing courtesy and readiness to help; to Mr. George J. Shave for drawings and information on technical matters; to the makers of various cars for the use of drawings and illustrations, many of which were merely for my own guidance and are not reproduced here; to the editor of the *Daily Mail* for permitting me to resume the substance of an article entitled "The Road to Ireland," which I contributed to that paper; to Mr. W. E. Garrett Fisher, for valuable help in reading proofs; and to Lady Jeune, Sir Horace Plunkett, Mr. St. Loe Strachey, Major Lindsay Lloyd, Mr. Charles Jarrott, and Mr. Rudyard Kipling for permission to reproduce the letters from them, which appear in Chapter XIII.

As it is my wish to keep this book up to date, I shall be glad to have any mistakes pointed out to me, and to be informed of any developments or alterations in the cars and systems described.

A. B. F. Y.

36, ROLAND GARDENS, S.W., *May*, 1904

INTRODUCTION

IN the early days of a movement that affects the common life of our age, and before we have learned to take all its new conditions for granted, it is worth while to consider its effect upon our life and to realise what we are likely to gain and lose by it. Rapid as has been the development of the motor-car as a social and industrial factor during the last few years, it is still regarded by the majority in no graver light than as an increase in the means of amusement of the well-to-do. The fact that the rich have been the pioneers of the new means of transport, and still enjoy almost a monopoly of its benefits, seems to have misled many people into the belief that it has no very important bearing on the circumstances of any other class; and this merely because a state of affairs incidental to its early development has been mistaken for something essential and inherent in the thing itself. But the motor-car is not destined to remain in these conditions. Like the bicycle, which was not so long ago the fashionable toy of the rich, and is now the necessary servant of the poor, the motor-car will ultimately find its level in the class that has most need of it. In the meantime the ground is being broken, and the present users of motor-cars are taking their share in the expensive stages of experiment by which all will ultimately benefit. In this way, and almost in spite of themselves, the luxurious classes are bearing their part in a great and beneficent work of social reform. And even to those of us who are not rich nor luxurious, but who have managed to possess and enjoy motor-cars, this thought may perhaps be a little comforting what time the bill, big with heart-breaking items, comes in from the repairer.

A very little thought will surely convince the most conservative of the social mission of the motor-car to a nation suffering from a lack of space, of fresh air, and of the mental stimulus of observation and enjoyment. In spite of all our advances and reforms, travelling in England, especially for the dwellers in large towns, is slow, expensive, and laborious. To travel from Wandsworth to Finchley, for example, is infinitely more troublesome than to travel from Manchester to London, and may take very nearly as long. The depression that comes from living constantly in one place, and from the feeling of helplessness to escape from that place, has probably a much graver and wider influence among people of narrow means, and through them on the nation as a whole, than many of us imagine. Overcrowding is a constant problem with us, and an acute evil; yet our only solution of it so far has been to extend the cities and so gradually enlarge the infected areas. The economic conditions that exist in England will probably always prevent the hearts of our great cities from being made into places fit for human habitation; so that the ultimate solution of this difficulty with us will probably be a development of the suburban principle as it now exists—that is to say, the cities will be used only for work during the day, and the workers will live at a distance from them, in surroundings dedicated to rest and enjoyment, and not to pain and toil. In this movement, which is even now beginning, the automobile will play an all-important part; and whether it flies through the air or goes upon the ground it will be available for those who labour and who need it most, and it will be available for them a fraction of a second the sooner for everyone who buys and runs, perhaps at grievous expense, a motor-car to-day.

That we are losing, and shall lose, something by it, I have no doubt. For every stage in our civilisation we pay a price; for every virtue that we gain we lose a virtue esteemed as of less account; for every pleasure found there is a pleasure lost; and no one who looks about him need look far to see what we are

losing by our acquisition of the motor-car. The fact that it is there—alluring and fascinating in its magic powers of carrying us so quickly in the wake of our wishes—secures for it without a struggle the allegiance that used to be given to quieter and more sober pleasures. It is the typical recreation of a restless and hurried age. Perhaps we need not blame it for taking from us what we were probably destined to lose in any case; but there is no doubt that the power of taking our enjoyments quietly, of finding pleasures in very simple things, of amusing ourselves with bare facts like trees and friends and fresh air and mountains, is going from us, and will probably not return. Where we used to savour and enjoy them singly, we now take them in whole gulps. One sees it around one, and is conscious of it in oneself, with vain regret; for the wheel upon which we and our empires and worlds are bound spins with a momentum that all our regrets cannot retard or turn back. But it is never a bad thing to remember in the pride of new powers, new pleasures, and new capacities for pleasure, that we may be discarding, like worn-out garments, other powers and pleasures that were good enough for better men. At any rate, if we are motorists, it may make us a little more tolerant of those who do not like us.

There need here be no disguise of the fact that motorists are not liked by the public at large; there is, indeed, no reason why they should be liked. We do not even like each other much; but we like ourselves immensely, and naturally we tend to become immensely selfish. And it is an unhappy quality of a thing like this, which is still the privilege of the few, that it appeals to selfish people, and makes even others seem selfish. Moreover, it is a pity that motorists lie so much, even to each other. The fishing lie has served a long and honourable term as representative of expert lying; but the motor lie is enough to make even a fisherman tell the truth in disgust. Whether the liar (I mean the motorist) drives a 5 h.p. "Baby Avalanche," or what Mr. Dooley calls a "40 h.p. Suffer Little Children," his

method is the same ; and it is always the same dreary story of how he "did" a distance of so many miles in such and such a time. The story always begins in the same way. "I wasn't thinking of going fast; we ambled along very slowly and stopped half an hour for lunch; one of my cylinders was missing too, yet we did the whole distance in three hours. I couldn't believe it when I saw the time we arrived." It is strange that people should take pleasure in such childish and transparent deception ; for they apply themselves to it with all the seriousness of disciples and enthusiasts. But they must not wonder if other people still unbaptised with the spirit of the new craze should dislike them very heartily.

I am afraid that to the man who is not yet a motorist it is the disadvantages rather than the advantages of the new movement, its present evils rather than its promised benefits, that most strongly appeal. Yet even to him I would suggest that there is a profit in looking a little ahead, in not confounding the wonderful mystery of speed and power with the crazy fellow who for the moment controls it, in seeing beyond the mere unsightly engine of our imperfect contriving to the truth and ideal for which it stands. Considered in this light, the motor-car is not the rich man's toy, the idle man's excuse, the brutish man's weapon ; it is a good genius, a physician of the mind and body, a spirit that will make of poor men's wishes wings to carry them out of themselves and their surroundings, out of darkness into sunlight and the pure air.

THE COMPLETE MOTORIST

CHAPTER I

THE EVOLUTION OF THE MOTOR-CAR

A wandering idea—Motoring in the eighth century—The wings of the wind—A gorgeous toy—Sir Isaac Newton's car—The treadmill—French geared carriages—The first steam carriage—Invention in England—The father of the locomotive—Heats and jealousies—End of the first period—The reform of the roads—The golden age of the steam carriage—Gurney's difficulties—Hancock's steam coaches—The effect of the tolls—Destruction of an industry—The railway boom—Gottlieb Daimler—The discovery of the gas engine—The first Panhard—Peugeot and Benz—The great competition of 1904—Serpollet and De Dion—The Paris-Bordeaux race—The Automobile Club of France—England begins again—The Parliamentary struggle—Waiting for the roads.

I

TO move about from place to place without the trouble of walking has been the luxurious necessity of man ever since he first began to enjoy the fruits of knowledge. For a long time it was enough that some fellow-creature—man or beast—should toil and sweat at his bidding and drag him about whithersoever his fancy drew him. But there came other dreams, other ideas of luxury—a carriage that would go by itself; a magic chair that would transport its occupant from place to place, proceeding by invisible machinery and moved apparently by its own volition: there was a majesty, a glorious impossibility, a splendid disdain of limitations in that idea that must have inspired its first entertainer with an almost intoxicating pride. Even to-day, when the thing is a commonplace and a matter of universal experience, the embers of that fire of

enthusiasm which first possessed the contemporary of Heliodorus still remain. The railway engine, the modern motor-car —who with any imagination can fail to thrill a little with the consciousness of the miracle that is worked by these when they serve his needs and desires? Who but has known at some time or other an infinite warmth and gratitude at his heart when he has felt the beat and quiver of steel limbs spurning and spinning out the miles behind him? Who could fail of some affectionate impulse when he realises of what wishes and longings, what aching desires and burning regrets, the device of automobilism has been born? For all the longings, all the thoughts and wishes that we can send round the world, all the most powerful of our spiritual movements, are helpless to join friend with friend, enemy with enemy, supply with demand, and impotent in themselves to fulfil the imperious necessities of business, revenge, or love. Helpless, that is, until they have expressed themselves; until they have translated themselves from emotion into thought, from thought to action, from action, through patience and anger, discovery and disappointment, death and fires, perils and bruises, sickness and losses, grief and happiness, to the few shapes of steel and iron that can bring our sluggish bodies careering in the wake of our quick thoughts.

But ideas have a life that is independent of the brains they inhabit; and the idea that gave rise to Heliodorus's description of a self-moving chariot continued to be blown about in the world long after he had been resolved into dust and memory. Not yet, however, was the brain—or rather the congregation or community of brains—ready for its reception. It was as yet but a homeless, restless, futile idea, incapable in itself, a stranger to the environment that could give it form or expression—a seed without soil or sun. Here and there, indeed, it found a temporary soil. Centuries old, it lodged in the brain of some Chinese mechanic who caught a glimpse of its possibilities, but could get no farther than a wheeled waggon rowed or punted along with poles. That was in the seventh or eighth century; and eight centuries later the idea had seen no further development in China, where the rowing carriage was still the latest thing in locomotion. Elsewhere it blossomed into brief, transient expression, always living a little longer in each new brain, taking a more definite form in each new device. Leonardo da

Vinci in the fifteenth century made some rough plans for an auto-car; strange savants in Persia were about the same time busy on some similar sketches; but in none of these cases did the idea come to any practical embodiment. And until the seventeenth century it may be said still to have been a wanderer, hardly increased by its transitory establishments, its purpose hardly advanced by all the mental energy that in workshop and monastery and rose-filled garden had been so warmly and hopefully devoted to it.

But in the seventeenth century the idea began to be busy in the Western world, and in the seventeenth century it took its first definite shape, and rooted itself, no longer in the minds of individual men who were far in advance of their time, but in the common mind of the age. In France and Germany and England—but especially in England—a body of thought was definitely devoted to the cultivation of this idea of auto-locomotion; and the seventeenth and eighteenth centuries may be said to have seen the development, perfection, and abandonment of an auto-motive system in which a mechanical motion was applied to wheeled carriages by means of the movements of men or horses carried on the vehicles themselves; and also of a system of wind-carriages or land-boats, in which the motive-power was the wind, acting either on sails or on some simple rotary mechanism.

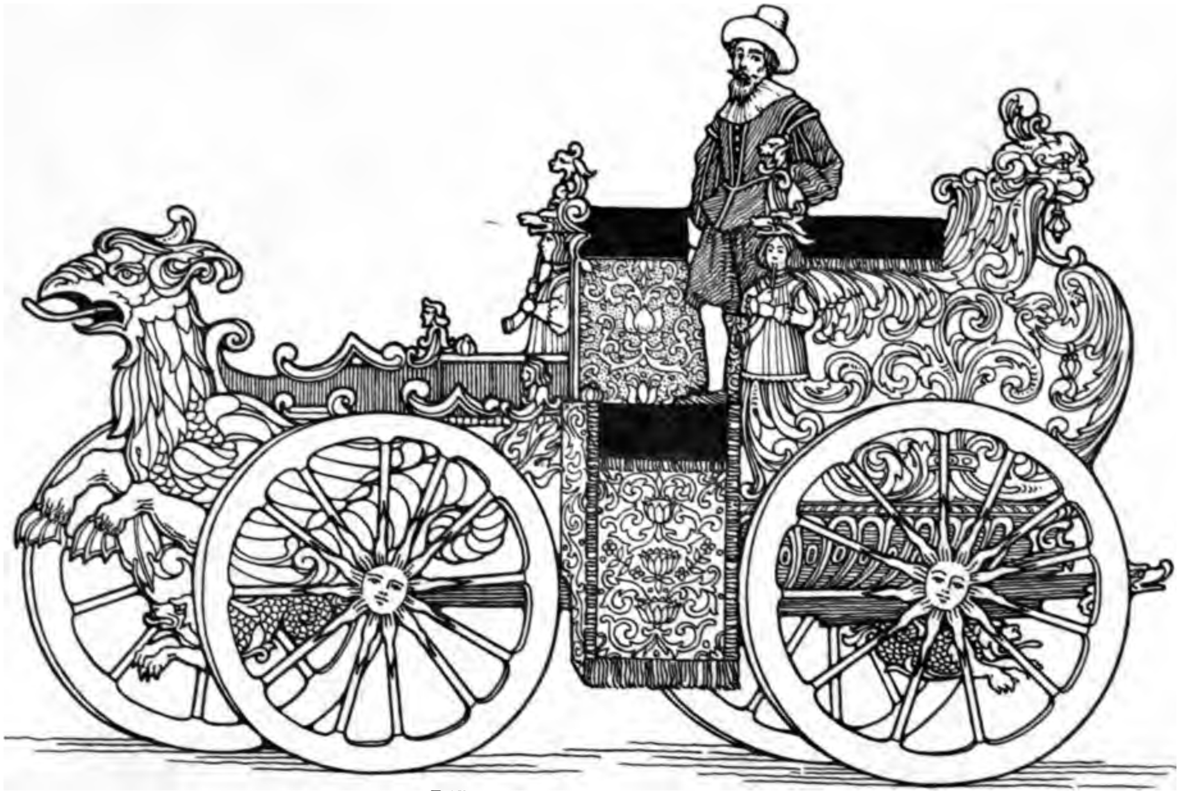
The records of this period are profoundly interesting. It can hardly be called more than a groping after the idea of auto-locomotion, for the conditions of mechanical science were as yet too crude to admit of much advance. The world was waiting for steam, as to-day it is waiting for the control of electricity; and in the meantime it fumbled blindly with certain mechanical principles, to the full use of which steam was destined to supply the key. Upon this period of groping the curtain lifts in the year 1600, and shows us the mathematician Simon Stevin working at his wind-carriage in his workshop at the Hague. This was a vast tray or coffer of timber, carried close to the ground on four wooden wheels some five feet in diameter, the after axle being pivoted to form a rudder. It was rigged with a tall mast amidships and a smaller foremast, both of them stayed aft and carrying large square sails. A trial run was made along the coast from Scheveningen to Petten with twenty-eight people on

board, including Prince Maurice and the Spanish Admiral Mendoza, who was at that time Prince Maurice's prisoner; and an average speed of twenty-one miles per hour was attained on the journey. Howell wrote of this same machine in the year 1650: "This engine that hath wheels and sails, will hold above twenty people, and goes with the wind, being drawn or mov'd by nothing else, and will run, the wind being good, and the sails hois'd up, above fifteen miles an hour upon the even hard sands."

STEVIN'S SAILING CARRIAGE, 1600

There was a similar carriage, but of smaller size, also built by Stevin, which remained for long at the Hague (the one mentioned in *Tristram Shandy*); but what subsequently became of either of them is not known.

The next date on which we have news of the auto-motive idea is 1618, when patents were taken out in England by one Thomas Wildgosse for various vehicles, such as ploughs, carts, and boats, to be drawn without horses or sails. The mechanism is not described, but is almost certain to have been some kind



THE NUREMBERG CARRIAGE, 1649

of gear worked by the hands of a person seated in the vehicle. Similar patents were applied for in 1625, but there is no record of the vehicles themselves.

But the first really successful carriage constructed for running on ordinary roads was made in Nuremberg by Johann Hautsch. The illustration of this carriage shows it to have been typical of that golden age of craft in Germany when no piece of work was turned out without being finished in every detail with the greatest possible perfection of art. Although it looks like a gigantic toy—and, indeed, in those days, when our world was in its childhood as regards machinery, every machine was a toy—the design is full of merit; and although the carriage was worked by toiling men, these were decently concealed in its depths, and nothing was visible but the stately carved carriage itself proceeding along at something like two miles an hour, with the mechanical figures in its woodwork sounding mechanical trumpets, and the weird dragon in front rolling its practicable eyes and spouting water from its practicable mouth for the purpose of clearing a way before the chariot. When I look at the picture of this gorgeous toy I do not wonder that the Crown Prince of Sweden purchased it; and I wonder still less that the King of Denmark (filled, it would seem, with envy) had one exactly like it made immediately afterwards.

In 1655 Sir Isaac Newton, then a boy at school in Grantham, contrived a mechanical car or chair on four wheels which was moved by a handle or winch geared to one of the axles, and turned round by the person sitting in the carriage; and in 1663 a Mr. Potter contrived a cart which had legs instead of wheels, although in what way this was to apply to the improvement of road locomotion is a secret which we must suppose to lie buried with the dust of Mr. Potter. In 1664 Hooke, the friend of Sir William Petty, a man of celebrated mechanical ingenuity, contrived and took out a patent for a single-wheeled vehicle which is supposed to have been propelled by the movements of a rider situated inside the wheel itself.

More successful, although still extremely crude, was the carriage invented by M. Richard, a French physician and scientist. In this carriage the power was applied by a man standing behind the seated occupant of the carriage and working levers with his feet. These treadles were hinged at their

rear ends, the forward ends being connected by a rope passing over a pulley above them. Thus when one was up the other was down, and their up and downward movements were arranged to engage two cogged wheels keyed on to the rear axle of the carriage. The forward axle was pivoted at its centre, and the vehicle was steered by two ropes held by the seated occupant. The front view of this carriage was not unsightly, and its motive power apparently mysterious enough; but the back view, revealing a perspiring servant at work on a treadmill, must have been more grotesque than dignified, nor can it have added much to the pleasure of any occupant of the carriage other than a confirmed cynic. An adaptation of this machine allowed of its being worked by the passenger himself—a doubtful improvement from the passenger's point of view, and one that (as Hooper in his *Rational Recreations* points out) must "on a rough or deep road be attended with more pain than pleasure." This was a French invention; and how little method or co-ordination there was in these tentative methods towards auto-locomotion may be realised from the fact that the next recorded invention—that of Sir Humphrey Mackworth in South Wales—consisted in the application of sails to colliery waggons travelling on a tramway. A contemporary admirer wrote to Sir Humphrey Mackworth that he was "the first Gentleman in this part of the World that hath set up Sailing-engines on Land driven by the Wind, not for any Curiosity, or vain Applause, but for real Profit, whereby he could not fail of Bishop Wilkin's Blessing on his Undertaking in case he were in a capacity to bestow it."

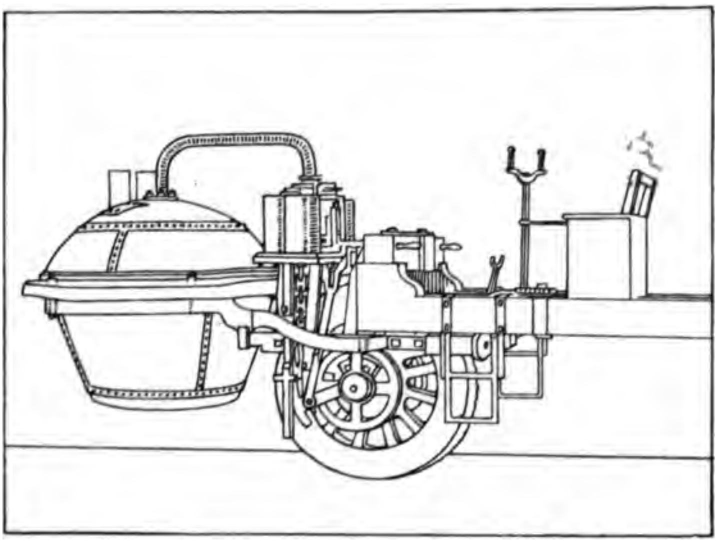
M. Beza, another French physician, invented in 1710 a mechanical chair, running on small wheels, chiefly intended for the use of invalids. The chair was drawn by a belt connected with the rear axle, and was probably similar to Sir Isaac Newton's carriage already described. A year later an advertisement appeared in the London newspapers of carriages to be driven without horses, "an invention of a wonderful chariot in which Persons may travel several miles an Hour, without the assistance of Horses, and measure the Miles as they go; it turns or goes back; having the Praise of all Persons of Quality and ingenious Men that have seen it." These carriages, which do not appear to have come into any degree of popular favour,

were apparently on the plan of Richard's mechanical chair, and were driven by a servant either working treadles or turning a winch.

A new use of wind in the propelling of road waggons was tried in France in 1714 by M. Du Quet. Instead of sails this inventor designed a small windmill, the rotary movement of which was transmitted in one case to two pairs of legs fixed on either side of a wheeled waggon, the forward motion being imparted by the alternate thrusting forward and pulling up of the legs; and in the other of a direct gearing from the windmill to the wheels themselves by ratchet bars and pinions. As in the case of so many other ingenious inventions it is not known whether this particular system was carried any further, but probably it was not. Another and still more ingenious application of the windmill, however, was described in 1760 by the Rev. J. H. Genevois, a Swiss clergyman. In this case it was proposed to use either a windmill or sails that should store energy in the carriage by means of springs, which could be used when the wind failed. The British Admiralty made some inquiries into this system, but it did not get beyond the stage of plans and models. There are a great many variations of these devices recorded throughout the eighteenth century, all providing either for the action of the wind upon the sails or vanes, or for the propulsion of the carriage from within by means of hand cranks or pedals. Spasmodic attention was, indeed, devoted to sailing carriages until quite late in the nineteenth century; but that was a mere offshoot from the main stem of development and was not destined to lead to any profitable result. Visitors to Southport will remember the sailing carriages which were in use on the sands there until quite recently. These were simply cutter-rigged boats mounted on two pairs of wheels; they could tack against the wind, and were capable of high speed; but the necessity for having an absolutely open space on which to move over, to say nothing of the caprices of the wind, rendered such devices useless for any practical purpose.

During the eighteenth century, however, experiments were being made with steam; and although it was not until late in the century that any attempt was made to apply it to road carriages, nevertheless much was done in evolving a sound

method of applying the expansive properties of steam in practical mechanics. Newcomen and Watt were busy on the cylinder and piston; but it was not until the year 1769 that it occurred to any to make some attempt to turn the reciprocating motion of the piston into a rotary movement which could be applied to the propulsion of a vehicle. Nicholas Joseph Cugnot, a French military engineer, designed in 1769 a steam carriage, which was built for him by Brezin, in which this principle was imperfectly applied; and in the following



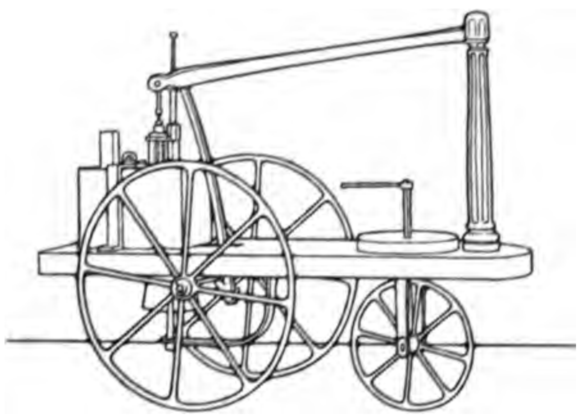
CUGNOT'S STEAM CARRIAGE, 1770

year an improved carriage was built at the Royal Arsenal in Paris by the order of the Minister of War. This machine still exists, and may be seen at the Conservatoire des Arts et Métiers, and a scale model of it has been erected in the South Kensington Museum, exhibit No. 96 of the Mechanical Engineering Collection in the Science Division. For political reasons this machine was never tried, but Cugnot's first machine was, and travelled on a common road, carrying four persons, attaining a speed of 2½ miles per hour. As the boiler capacity was insufficient, however, it was not able to run for more than fifteen minutes without pausing to get up steam again. Cugnot's

vehicle, which is of great interest, as being the first practical steam road vehicle, is a heavy three-wheeled lorry, carrying in front of it an overhanging copper boiler. The single front wheel, which is of great strength and weight, is driven by two single-acting vertical cylinders, 13 inches in diameter by 13-inch stroke. These two pistons are connected by a rocking beam, to which they are coupled by chains attached to levers mounted on the axle of the driving wheel. They alternately work the front wheel by pawls acting on two modified and reversible ratchet wheels. The distribution of steam to the two cylinders is effected by a four-way cock so arranged that in each position it opens one cylinder to the steam supply and the other to the atmosphere. It is operated by a tappet motion from the piston-rods. The rear part of the machine is connected by a vertical bolt to the front wheel; and by means of gearing from the driver's seat the fore-carriage can be turned through fifty degrees, thus enabling the driver to steer the carriage.

But France, after the invention of Cugnot's carriage, contributed practically nothing to the development of auto-locomotion for a full century. As Mr. Garrett Fisher has said, "before the Revolution she was too languid, after it too busy." For the next stage in its progress we must turn to England; and indeed to England belongs almost the entire credit for the evolution of the steam carriage. Richard Trevithick, whom Mr. Rhys Jenkins describes as "perhaps the greatest inventive genius that has ever appeared in this country, and the man who of all others is justly entitled to be styled the 'father of the locomotive,'" was a Cornish mining engineer who was engaged, in connection with the firm of Boulton and Watt, in adapting Watt's steam engine to the work of pumping water out of mines. He invented and constructed in the year 1800 the first steam carriage which carried people on English roads. Some years before this Watt had entertained the idea of a steam carriage, and even worked a little at designing one; but he could never bring himself to believe in its possibility, and his nearest approach to confidence was when he wrote to his partner Boulton, "I have one of some size under hand, and am resolved to try if God will work a miracle with these carriages . . . but I have small hopes of their ever becoming useful." Such a doubter

was not likely to achieve success; and it is a curious fact, and one by no means to Watt's credit, that even these faint-hearted efforts of his were chiefly inspired by jealousy and a fear that someone else should supersede him. He took out a patent in 1784, which included a steam carriage; this machine he admitted to have been "very defective, and can only serve to keep other people from similar patents." That he was haunted by the idea of auto-locomotion, but felt that he himself was unable to solve the problem presented by it, is obvious from his letters to Boulton. He continued to throw out suggestions and theories on the subject; but they were all concerned with details, and



MURDOCK'S MODEL STEAM CARRIAGE, 1784

avoided the real difficulties of the problem. He was more interested in proposing that copper would be a good material for the boiler than in solving the difficulty of designing a light boiler that would supply enough steam; and his childish theory that "the shaking of the carriage would supersede the necessity of poking the fire" shows upon what trifling matters his attention was fixed. His whole attitude with regard to the subject of steam carriages is unworthy of a man whose fame is and must for ever be inseparable from the history of the steam engine.

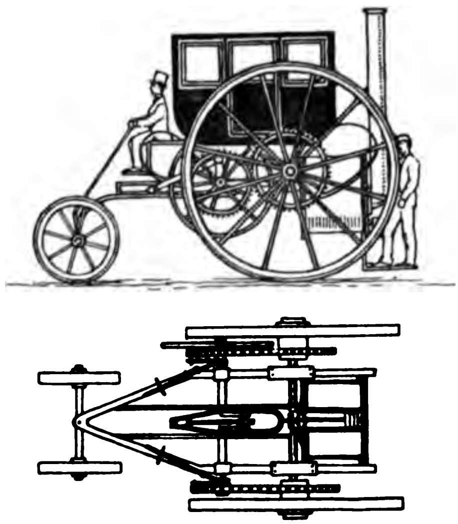
The real cause of Watt's alarms and jealousies seems to have been the activity of his assistant, William Murdock, who in 1784 had constructed a model steam carriage. This was a very simple, three-wheeled affair, with a single cylinder, the piston of

which was directly attached to a rocking beam. It is interesting because it contains the first application of the crank to convert the up-and-down motion of the piston-rod into a circular motion. A rod connected the rocking beam with a crank fastened to one of the rear wheels, thus driving the carriage. This model was tried on the road one dark night in the village of Redruth in Cornwall, when it ran away from its inventor, and nearly frightened the village parson (who took it to be the devil) out of his wits. For two years Murdock continued to work in his spare time at his model, and in 1796 informed his principals, Boulton and Watt, that he had succeeded in constructing a satisfactory steam-carriage. But this so alarmed the jealous Watt that he provided his clever assistant with work which kept him closely occupied, and so prevented him from devoting any more time to steam carriages.

In this same year Trevithick, who was also engaged in mining work in Cornwall, constructed his first model steam carriage. This, again a three-wheeled vehicle, is driven by a vertical engine, the cylinder of which is placed partly in the boiler. Side rods connect a cross-head on the piston-rod with crank pins on the rear wheels, which are also connected by toothed gearing with a fly-wheel. In 1801 Trevithick's experiment had developed so successfully that he began the construction of a full-sized carriage, which was finished before the end of the year, and made its trial trip on Christmas Eve. The carriage, carrying seven or eight people, was driven up Camborne Beacon for half a mile "faster than a man could walk." In 1802 Trevithick took out a patent for his improved steam carriage. The vertical boiler and engine had been abandoned in favour of the horizontal position, and instead of direct coupling to the wheels he employed a crank shaft, which was geared to the main road wheels by spur wheels. Trevithick pointed out that "the power of the engine with regard to its convenient application to the carriage may be varied by changing the relative velocity of rotation of the road wheels, compared with that of the crank axis, by shifting the gears or toothed wheels for others of different sizes properly adapted to each other"—thus anticipating the modern change-speed gear used in connection with petrol engines. But, like so many even of the successful inventors of the period, Trevithick soon discontinued his experiments in road loco-

motion. He turned his attention to tramways and railway engines; but even here, although he exhibited an engine running on an experimental circular track in London, he received such scant encouragement that he abandoned locomotive engineering for other pursuits.

With this inventor, and with the eighteenth century, the first period of experiment may be said to have ended. The condition of the English roads was such that even had a practical steam road-carriage been built, its use would have been almost



TREVITHICK'S STEAM CARRIAGE, 1802

impossible. Arthur Young, the great reformer of English agriculture (1741–1820), wrote of English roads at the end of the eighteenth century that there were only four good ones—the road from Salisbury to Romney, the North Road from London to Barnet, the road from London to Chelmsford, and a length of new road in Wales. So we must picture England, where the idea whose early wanderings we traced at the beginning of the chapter had at last found a likely and hopeful soil, still unprepared to make use of the new power that was being cradled within her shores. Rain-visited landscapes, as to-day, darkened by clouds and bleak of climate; tracks and lanes ploughed

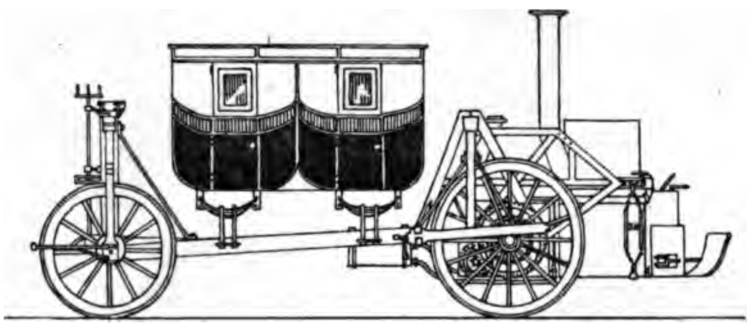
through pasture and park, deep in mud and mire, sown with pitfalls, interrupted by chasms and subsidences, never drained, but lying saturated and stagnant in oozing filth ; communication between places slow, laborious, and dangerous, involving long journeys on horseback or by the lumbering, hazardous coaches —these were not conditions likely to encourage the application of brains, time, and money to problems of road locomotion. So far our idea had but hovered about the workshops and the designer's office ; and it was not until the next period, embracing the second quarter of the nineteenth century, that it found itself upon the open road.

II

The beginning of the nineteenth century brought to recognition the work of two men whose work was destined to have a remarkable effect on the development of auto-locomotion. Thomas Telford, the son of an Eskdale shepherd, began his career by being apprenticed to a stonemason, and made such progress that at the beginning of the century he was County Surveyor of Shropshire, had constructed the Ellesmere Canal joining the Mersey, Dee, and Severn, and built various aqueducts and iron bridges. In 1802 he began his work on roads, and in the eighteen years following he made and opened 920 miles of good road and 1,200 bridges. Telford's system of roadmaking was expensive and elaborate, as all sound roadmaking must be. The bottom course was of freestone blocks set into their places by hand, with the spaces between them filled and packed and rammed also by hand. At every hundred yards a drain was set right across the road, and a second course was then laid of small broken whinstones. The top or binding course was of one inch of gravel, which readily bedded down and made a clean surface. The improvement effected by Telford's scientific methods may be imagined when we remember that hitherto roads, where they had been laid at all, had simply been laid with cartloads of round flints and gravel, which the wheels of heavy waggons, instead of rolling and consolidating, ploughed into ruts.

Macadam, an Ayrshire roadmaker, was also working a revolution in the methods by which the bridle tracks and roads were

kept up. Before his time they were maintained by statute labour, which was as much hated and neglected as the French system of *Corvée*. The system of tolls was instituted instead of the statute labour, with the result that the roads became immediately passable by chaises and coaches. Macadam made a further improvement on Telford's system by substituting for unbroken flints the angular granite fragments, now known as road metal, which have ever since formed the smooth hard surface with which his name is associated. These two men practically rediscovered the art of roadmaking, which had been lost in England for so long, and their work survives to-day in the fine English main roads, which have made the development of automobilism at once possible and pleasant. No one can

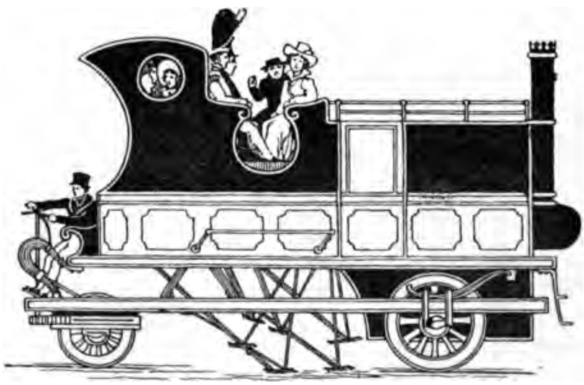


CARRIAGE BY JULIUS GRIFFITHS, 1822

travel on, say, Telford's Holyhead Road without admiring its beautiful surface, its fine curves and easy gradients, its noble width, its bridges and culverts, without a keen sense of admiration for the man whose life-work took so grand and dignified and lasting a form. With the improvement in the roads came a sudden stimulus in the building of steam carriages. Mr. Rhys Jenkins notes that between the years 1832 and 1838 there were not far short of a dozen companies formed to work lines of steam coaches. He mentions among others the London and Birmingham Steam Carriage Company, 1832; the Paddington and London Steam Carriage Company, 1832; Heaton's Steam Carriage Company, 1833; the London, Holyhead, and Liverpool Steam Carriage and Road Company, 1834; the Steam Carriage Company of Scotland, 1834; the Hibernian Steam

Coach Company, 1834; and the Steam Carriage and Waggon Company, 1838.

✓ There was no dearth of engineers working at steam-carriages to supply this new demand. The carriages of Griffiths, of Gordon, of Brunton, of Burstall & Hill, of James & Anderson, of Henry Peto, and of James Nasmyth were all improvements on anything that had been done before, and many of them successfully carried heavy loads of passengers; but it was not until Goldsworthy Gurney (1793–1875), who, when a boy in Cornwall, had seen Trevithick working with his models, himself turned his attention to the construction of steam coaches that they came into use as public conveyances. In 1827 he had

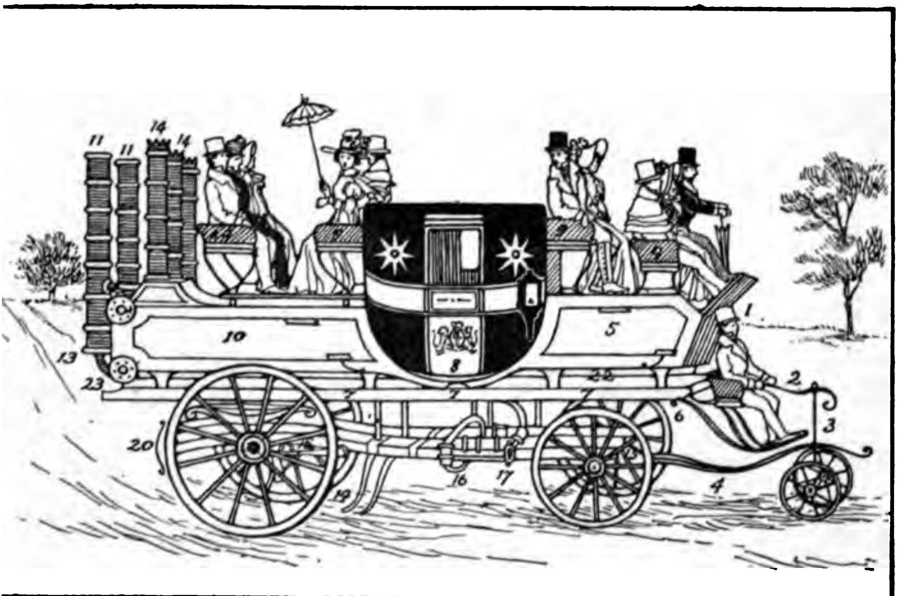


STEAM CARRIAGE BY DAVID GORDON, 1824

constructed a large coach capable of carrying twenty-one passengers, the steam being generated in a water-tube boiler fitted with steam drums, or separators, for the purpose of ensuring a supply of dry steam for the cylinders. In this first carriage Gurney fitted propelling legs in addition to the usual mechanism for driving the wheels, as he was afraid that in starting the wheels would simply turn round and not move the carriage. These, however, were abandoned in his later models. This carriage made many runs in the neighbourhood of London, sometimes attaining a speed of fifteen miles an hour, and was afterwards sent to Wales, where it remained in use as a tramway locomotive for two years, during which period it only needed the slightest repairs.

The following table of references to the print of Goldsworthy Gurney's steam-carriage appeared in the *Mirror of Literature, Amusement, and Instruction*, 15 December, 1827 :—

1. The Guide and Engineer, to whom the whole management of the machinery and conduct of the Carriage is entrusted. Besides this man, a Guard will be employed.
2. The Handle, which guides the Pole and Pilot Wheels.
3. The Pilot Wheels.
4. The Pole.



GURNEY'S FIRST STEAM COACH, 1827

5. The fore Boot for luggage.
6. The "Throttle Valve" of the main steam-pipe, which, by means of the handle, is opened or closed at pleasure, the power of the steam and the progress of the carriage being thereby regulated from 1 to 10 or 20 miles an hour.
7. The Tank for water, running from end to end and the full breadth of the carriage : it will contain 60 gallons of water.
8. The Carriage, capable of holding six inside-passengers.
9. Outside Passengers, of which the present carriage will carry 15.
10. The Hind Boot, containing the Boiler and Furnace. The

Boiler is encased in sheet-iron, and between the pipes the coke and charcoal are put, the front being closed in the ordinary way by an iron door. The pipes extend from the cylindrical reservoirs of water at the bottom to the cylindrical chamber for steam at the top, forming a succession of lines something like a horse-shoe turned edgeways. The steam enters the "separators" through large pipes, which are observable on the Plan, and is thence conducted to its proper destination.

11. "Separators," in which the steam is separated from the water, the water descending and returning to the boiler, while the steam ascends and is forced into the steam-pipes or main arteries of the machine.

12. The Pump, by which the water is pumped from the tank, by means of a flexible hose, to the reservoir communicating with the boiler.

13. The Main Steam-Pipe, descending from the "Separators," and proceeding in a direct line under the body of the coach to the "throttle valve" (No. 6), and thence under the tank to the cylinders from which the pistons work.

14. Flues of the Furnace, from which there is no smoke, coke and charcoal being used.

15. The Perches, of which there are three, conjoined, to support the machinery.

16. The Cylinder. There is one between each perch.

17. Valve Motion, admitting steam alternately to each side of the pistons.

18. Cranks, operating on the axle; at the end of the axle are crotches (No. 21) which, as the axle turns round, catch projecting pieces of iron on the boxes of the wheels and give them the rotary motion. The hind wheels only are thus operated on.

19. Propellors, which, as the carriage ascends a hill, are set in motion and move like the hind legs of a horse, catching the ground and thus forcing the machine forward, increasing the rapidity of its motion and assisting the steam power.

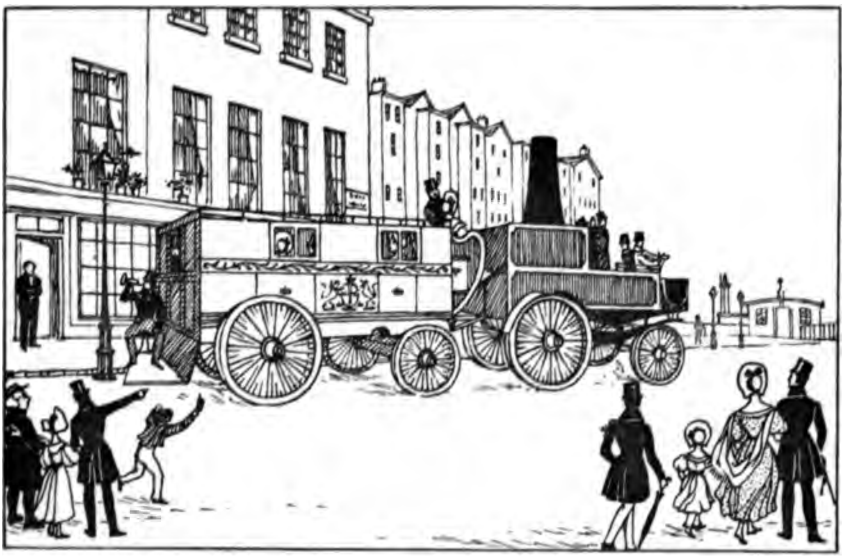
20. The Drag, which is applied to increase the friction on the wheel in going down a hill. This is also assisted by diminishing the pressure of the steam—or, if necessary, inverting the motion of the wheels.

21. The Clutch, by which the wheel is sent round.

22. The Safety Valve, which regulates the proper pressure of the steam in the pipe.

23. The Orifice for filling the tank. This is done by means of a flexible hose and a funnel, and occupies but a few seconds.

Gurney, like many pioneers, had to put up with a good deal of stupid opposition as well as open hostility. On one journey which he made to Bath with a number of guests his carriage was attacked at Melksham, where there happened to be a fair. The people formed such a dense mass that it was impossible to move the carriage through them; the crowd, being mainly composed of agricultural labourers, considered all machinery directly injurious to their interests, and with a cry of "Down with all machinery," they set upon the carriage and its occupants,



SIR CHARLES DANCE'S CARRIAGE, 1833

seriously injuring Mr. Gurney and his assistant engineer, who had to be taken to Bath in a post-carriage in an unconscious condition.

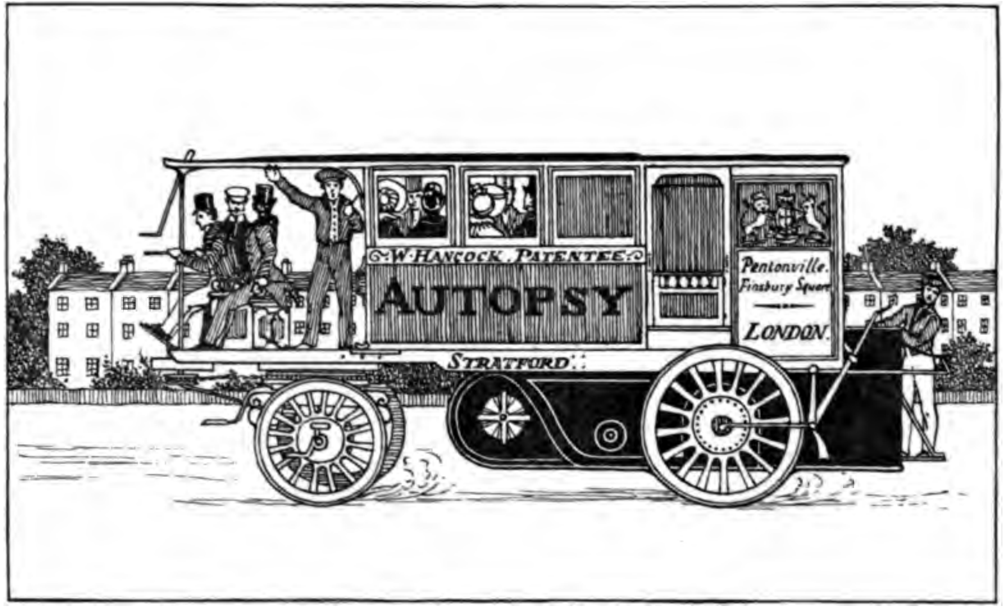
Gurney, however, was not so easily disheartened as some of his predecessors. He continued working at his carriages, and in 1831 Sir Charles Dance started a service of steam carriages between Cheltenham and Gloucester, which was worked by Gurney drags. In spite of local feeling (which was still very hostile, and manifested itself by attempts at wrecking), the project was successful; and during a period in which some four hundred journeys were made the steam coaches earned a profit

for their owners. This service continued until in 1840 it and all similar enterprises were killed by the stupid imposition of ruinously heavy tolls on self-propelled vehicles. Gurney's price for a steam coach was £1,000, and his royalty on all public services which used them was sixpence a mile. In spite of this his losses caused by the tolls were so heavy that a committee of the House of Commons appointed to consider the matter recommended a grant to him of £16,000 in recognition of his public services.

More successful than Gurney was Walter Hancock (1799–1852), a mechanical engineer of London, who early in his career devoted himself to the steam-carriage problem. His machines were much more practical than anything that had been made

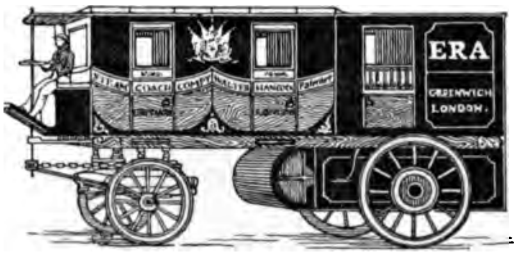
JAMES'S STEAM CARRIAGE, 1824

before, and he introduced many improvements. He increased the boiler pressure, which had hitherto been anything between 10 lbs. and 50 lbs. per square inch, to 100 lbs. per square inch. His boiler consisted of a number of vertical rectangular compartments placed above the fire-grate and connected by tubes at top and bottom, a forced draught being formed by a fan at the top of the fire-box. His engine was vertical with two cylinders, and drove a crank shaft geared to the main axle—not, as before, by cog-wheels, but by chain of improved construction. The engine was placed in a separate compartment where it was possible to keep it clean, and for the first time a clutch was used to throw the engine in and out of gear, so that when the carriage was stationary the feed-pump and furnace fan might still be driven. Hancock built about ten vehicles and gave them all names; the most famous of them were the "Infant,"



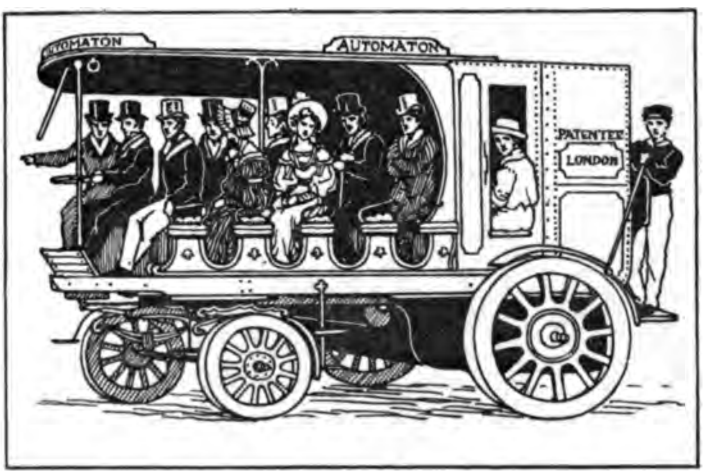
HANCOCK'S "AUTOPSY," 1833

the "Autopsy," the "Era," the "Enterprise," and the "Automaton." Hancock paid much attention to the comfort of his passengers, and altogether improved the carriage portion of his vehicle as well as the machinery. He worked a most successful



HANCOCK'S STEAM COACH "ERA," 1833

service of cars between the City and Paddington, beginning in the year 1834, which, until the year 1840, was conducted at a profit; after which year Hancock devoted himself for a time to railway locomotive construction. He felt that he had not re-



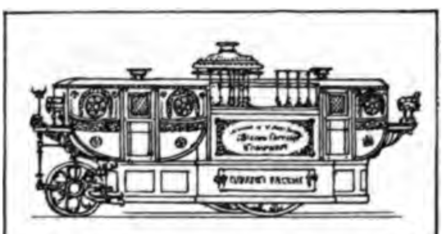
HANCOCK'S "AUTOMATON," 1836

ceived the official recognition which the perfection of his vehicle and the success of such services as he was able himself to conduct undoubtedly warranted; and it is true that he solved many a problem which (owing to the foolish legislation that

killed automobilism in this country) has had to be studied and solved again in our own day.

Until the year 1840 several engineers continued to build steam coaches and to run them successfully on various public

CHURCH'S STEAM COACH, 1833

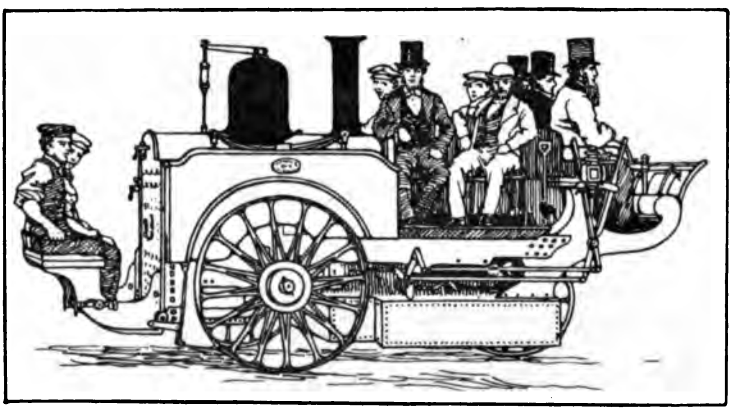


SIDE VIEW OF CHURCH'S COACH

services. Dr. Church's steam coach (1833) was indeed a marvellous construction, in outline and ornamentation something between a gipsy van, a merry-go-round, and a ship's saloon. Other constructors of successful coaches were Maceroni & Squire,

Ogle & Summers, Hill, of Deptford, and the Steam Carriage Company of Scotland. But in 1840 the tolls had increased to such a point that it was impossible to run steam carriages profitably. A Parliamentary Committee appointed to consider the matter found that "on the Liverpool and Prescott Road

RICKETT'S CARRIAGE, 1861



CARRETT'S STEAM CARRIAGE, 1861

Mr. Gurney would be charged £2 8*s.*, while a loaded stage-coach would pay under 4*s.* On the Bathgate Road the same carriage would be charged £1 7*s.* 1*d.*, while a coach drawn by four horses would pay 5*s.* On the Ashburton and Totnes road Mr. Gurney would have to pay £2, while a coach drawn by four horses would be charged only 3*s.*" The development

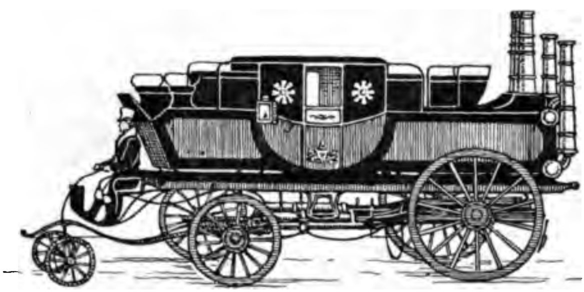
of railways at about this time also diverted public interest; while the railways themselves, short-sighted then as now, were actively hostile to road locomotion. So that gradually the steam coach disappeared from the roads, and attention was paid instead to the traction-engine and the use of mechanical tractors for driving heavy goods. With the development of these an agitation was raised against the toll laws, as a result of which laws were passed in 1861 and 1865 providing for a uniform scale of tolls throughout the country. As these Acts, however, regulated the weight and speed of the vehicles,

RANDOLPH'S STEAM CARRIAGE, 1872

they were useless for the purpose of passenger carriage, and, indeed, they effectually killed auto-locomotion on the roads of this country. All the pains and expense, all the time and patience that had been devoted to bringing this industry to the point at which it had arrived in 1840 were, if not actually wasted, at any rate robbed of their due development and reward. The industry in which England should have led the world was left to be taken up by other nations, who are still reaping the profit of their thirty years' start. Here and there, indeed, in this country an enthusiastic inventor would build a carriage in spite of the laws; here and there an adventurous citizen would buy and run steam carriages (chiefly by night) at the

risk of fine and imprisonment. The chief makers of these carriages were Rickett (1861), Carrett (1861), Yarrow & Hilditch (1862), Knight (1868), Catley & Ayres (1869), J. L. Todd (1879), Charles Randolph (1872), Blackburn (1878), and Inshaw (1881). But it cannot be said that, with the exception of Randolph's carriage, these vehicles presented any very novel or valuable features, or that they carried the evolution of the motor-car much farther than it had been brought by Hancock. As an industry the thing was dead.

Before we leave this period it is worth while to notice the curiously childlike enthusiasm which flourished in the palmy days of the steam carriage. These things were new toys to the nation, and were hailed by those manifestations of extrava-



GOLDSWORTHY GURNEY'S STEAM COACH, 1833

gance and zeal which mark the infancy of all such schemes. About the same time, or a little later, the same temper was seen in connection with the railways, over which the whole country went mad—an emotion which is expressed in a curiously accurate way in Frith's picture "The Railway Station." The reverent and solemn enthusiasm, the wildly sanguine and extravagant dreams—they are all there in the faces of the people, in the very arches and spaces of the station itself. It has its monument to this day in the portal of Euston Station—that monstrous mass; and you see it again applied to other departments of life in the Albert Hall and the Crystal Palace. But even to such things as these we may be reconciled if we take them as a sign that the world can always be young and can perennially exhibit the same droll infatuation with a new idea or a new toy. And so with the old steam coaches. Vast

unshapely bodies perched on uncouth frames and monstrous wheels, weirdly decorated, childishly emblazoned, riotously extravagant in bulk and weight, top-heavy and ill-balanced, grotesque and formidable, terrifying and ludicrous, belching clouds of black smoke and showers of cinders, enveloped in dust, their passage accompanied by the shrieks and barks of dogs, the whinnying panic of horses, the terror and delight of children, the wonder and admiration of the polite world—are they not, after all, typical of that joyful, sanguine enthusiasm over a new discovery that can hope all things, admire all things, endure all things? And would not one like to have been there some sunny morning when the "Autopsy" was starting from the "Angel" towards the Euston Road, or when the "Era," turning the corner of some Wiltshire greenwood, passed triumphantly on its way from London to Marlborough, with the children cheering and the dogs barking? We may be sure that its passengers tasted and enjoyed to the full those little pleasures and excitements of the open road—pleasures and excitements that we have only lately rediscovered.

III

So far the efforts to construct an auto-motive road carriage had concerned themselves almost exclusively with the steam engine. There had been a few attempts to use clockwork, and in 1870 a clockwork omnibus was constructed and tried in New Orleans. The great weight of metal, however, necessary to store power sufficient for any practical purpose led to the early abandonment of this method. There were also experiments made with compressed air; but here again, although in theory the system was a good one, practical difficulties proved insurmountable. The cost of compressing air on a small scale was considerable; the weight of the reservoir necessary for holding air stored at a high pressure absorbed a large proportion of the power developed; and there was an inevitable wastage caused by the reduction of pressure as the air was used. For single carriages, therefore, compressed air as a motive power proved unsuitable. Electricity, in the form of primary batteries driving magneto-electric motors, was also the subject of several experiments; but here again the system was thoroughly

unpractical, until in 1871 Gramme discovered that the dynamo when reversed was capable of developing mechanical energy. In spite of the great improvement effected by this discovery, a serious difficulty still remained in the necessity for carrying heavy storage batteries, which at the best could only furnish power enough for a very limited radius of travel; and this difficulty still remains.

But there was another kind of motive power, the application of which was destined to revolutionise the idea and practice of automobile construction. Gottlieb Daimler (1834–1900) was a mechanical engineer who had worked at his profession with some of the chief firms in England and Germany. In the year 1884, having then been for some time Director of the Otto Gas Engine Works at Deutz, he produced and patented a small gas-engine designed to run at very high speeds—so high that the heat generated by it was enough to ignite the charges of gas furnishing the propelling power. A description of the Otto cycle, which is the principle of all petrol engines, will be found in another part of the book; it is enough to say here that the motive power of such engines is furnished by a series of gas explosions taking place in the cylinder itself, so that the cumbersome attachment of boiler and furnace are done away with. The next year Daimler improved his engine by fitting a heavy fly-wheel and by enclosing the crank in a chamber in which a valve capable of opening inwards but not outwards was fitted. Through this valve the explosive mixture was automatically drawn by the upstroke of the piston. As soon as the piston began to descend again, the valve was closed, and the charge of gas consequently compressed within the crank chamber. Towards the end of the downward stroke a valve fitted in the piston itself was mechanically opened, thus allowing the compressed gas to fill the upper part of the cylinder. As the piston began again to travel upwards the valve in the piston was closed, and when the piston reached the top of its stroke the charge was fired by means of an incandescent tube. In order to keep the cylinder from becoming red-hot some form of cooling was necessary, and in Daimler's first engine this was effected by a fan.

In the year 1886 Daimler fitted this engine to a bicycle by placing it vertically between the front and rear wheels, the rear

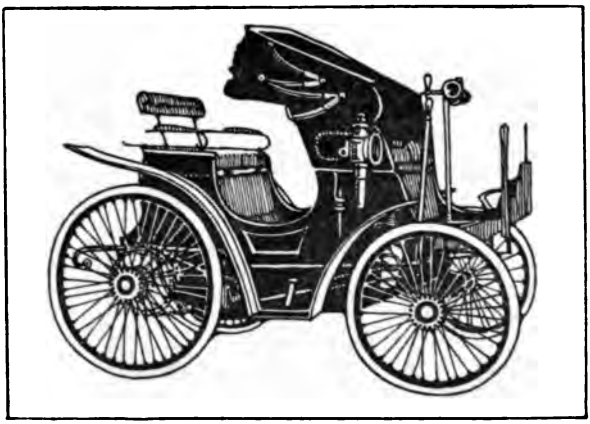
wheel being driven from the engine by means of a belt. Gas was supplied from a carburettor in which the necessary mixture of an explosive vapour was effected by causing the air to enter the liquid from below, thus combining with the vapour given off by it. This engine, crude as it was, proved so satisfactory that Daimler continued to work at it, and in 1889 constructed a two-cylinder engine the piston-rods of which were coupled to a single crank. /This engine was the first to attract the notice of practical engineers and to lead them to believe that the explosion engine could successfully be applied to motor-cars. The

GOTTLIEB DAIMLER'S BICYCLE, 1886

right to manufacture Daimler's engine was acquired in 1889 by Messrs. Panhard & Levassor, who immediately began the construction of motor-cars as we understand them to-day. The first Panhard car was brought out in 1891, and in that and the following three years they had constructed about a hundred cars. These cars were driven by Daimler's two-cylinder engine of about the same horse-power as we now apply to the lightest kind of motor-bicycle. They were, however, provided with great improvements in the way of transmission and control. The engine drove a longitudinal horizontal shaft (running beneath the frame) which was connected with a parallel shaft above it by means of cogged wheels of various sizes, thus providing for a

change of gearing and an alteration of the speed of the carriage while the speed of the engine remained constant. The upper longitudinal shaft drove, by means of a bevel gear, a transverse shaft, which in its turn was coupled by chains at either end to the driving wheel. It may truly be said that the latest devices used in a Mercédès or Napier, or any other car of 1904, are but an improvement and evolution of the features of these early Panhard cars.

At the same time the firm of Peugeot Frères was also building cars driven by Daimler motors. Their methods were much the



PEUGEOT BENZINE CAR, 1895

same as Messrs. Panhard & Levassor's, but the cars were somewhat lighter in construction, while the engines, instead of being placed in front as in the Panhard cars, were placed behind. Clutches were also used for throwing the engine in and out of gear; and the Ackermann system of carrying the front wheels on a rigid axle with pivoted ends was used for steering. Rubber tyres were used, and a maximum speed of from ten to twelve miles an hour was attained.

The pioneer work of Benz in the motor revival must not be forgotten. Quite independently of Daimler, and at about the same time (1885), he was building a gas engine to be applied to a motor-carriage. In his plan, which was retained in the Benz carriages for many years, the engine was placed at the rear of the carriage over the back axle. It drove a vertical crank

shaft, the chief object of this arrangement being to ensure stability in the steering of the car by the horizontal position of the fly-wheel. The crank shaft was connected by bevel-gearing to a short horizontal shaft; and this in its turn was coupled by a belt to a horizontal counter-shaft, the ends of which were connected to the road wheels by chains in the usual way. There were fast and loose pulleys for the belt, so that the engine could be run free when it was desired to stop the car. Benz's cylinders were cooled by a water-jacket, and at first were worked on the two-stroke cycle; but in the subsequent development of this engine in collaboration with Roger, of Paris, the Otto four-stroke cycle was adopted.

IV

Thus the idea of auto-locomotion grew and developed, and the method of applying it crept nearer and nearer to efficiency. By the year 1894 there were quite a number of carriages which could be driven upon the roads at speeds of from ten to fifteen miles an hour, with something like a certainty that they would arrive at their destination. Activity in the matter was practically confined to France, as the conditions of the law in England made it quite useless for engineers to spend their time on the development of road locomotion. But public interest and private enterprise had in 1894 brought matters to such a stage in France that it was felt that some means should be taken to draw together the various threads of enterprise and to consolidate individual efforts in a common movement. The proprietors of the *Petit Journal* therefore organised a meeting of automobile vehicles, which took the form of a run between Paris and Rouen in 1894. The announcement of this competition created an extraordinary amount of interest. Upwards of a hundred cars were entered for the contest. Only some twenty, however, ultimately presented themselves for the trial run, fourteen of which were driven by petrol engines, the remainder being steam cars. It must be remembered that at this period the steam engine had advanced much farther in efficiency and light construction than the petrol engine. The Comte de Dion and M. Serpollet—to mention only two of those who had been working at steam carriages—had achieved very satisfactory results with light boilers generating high-pressure

steam and very small engines. M. Serpollet's great invention was his boiler, the principle of which was that, instead of storing both water and steam, it generated steam instantaneously, as it was required, by means of flattened tubes of a very narrow section which were kept at a red heat by the furnace and through which the water was pumped and "flashed" into steam. At the Paris-Rouen contest the fastest performance was that of the de Dion Bouton steam carriage, which covered the distance—some seventy-eight miles—at an average speed of about twelve miles an hour. Almost all the other carriages, with the exception of those of le Blant (who used the Serpollet generator) and Scotte (whose vehicle was an omnibus driven by a simple two-cylinder engine supplied with steam by a Field boiler), were driven by Daimler motors, Messrs. Panhard and Peugeot dividing the first prize between them.

This historic meeting of Paris-Rouen was so successful and opened so wide a vista of possibilities for the motor-carriage, that it was decided to attempt the more complete organisation of the movement. On November 18th, 1894, several influential Frenchmen met at M. de Dion's house to decide on the next step; and it was then resolved that there should be a great road race from Paris to Bordeaux and back, a distance of 730 miles. Some of the names of those who attended this meeting deserve always to be remembered in connection with the science of automobilism. Among them may be mentioned the Baron de Zuylen, the Comte de Dion, the Marquis de Chasseloup-Laubat, the Comte de Chasseloup-Laubat, Messrs. Peugeot, Levassor, Serpollet, Roger, and Emile Gautier. The race upon which they had decided imposed an extremely severe test, as it was required by the rules that the journey should be performed in one trip, and that no repairs or replacements other than those possible by such apparatus as could be carried on the cars themselves were permitted; so that what was really demanded was the construction of vehicles which could travel on the common roads for forty-eight hours continuously at a high rate of speed. This severe test was triumphantly endured by about nine cars, which, out of the twenty-two that started, arrived safely back in Paris. The most successful performance was that of M. Levassor on a Panhard car, who accomplished the journey in forty-eight hours forty-eight minutes, having

only stopped for eight minutes at Bordeaux. In the words of the Marquis de Chasseloup-Laubat: "He did not appear to be over-fatigued; he wrote his signature at the finish with a firm hand; we lunched together at the 'Porte Maillot'; he was quite calm; he took with great relish a cup of bouillon, a couple of poached eggs, and two glasses of champagne; but he said that racing at night was dangerous, adding that having won he had the right to say such a race was not to be run another time at night." The car upon which this historic feat was performed was built specially for the race by Messrs. Panhard and Levassor; it was driven by a 4 h.p. Daimler engine, had three speeds, the highest of which was 18½ miles an hour, and its wheels were fitted with solid rubber tyres. Three vehicles built by Messrs. Peugeot came in very soon after M. Levassor; and after them came two Rogers and two more Panhards. Steam was successfully represented by a large omnibus built by M. Amedée Bollée, which carried eight persons throughout the trip. M. Serpollet had entered a car, which, however, failed to complete the journey without a serious breakdown—a fate which was shared by the de Dion cars. This contest saw the first appearance of pneumatic tyres in long-distance automobile races, one of the competing (but unsuccessful) cars being fitted with Michelin tyres. The committee which had organised this race took a further step towards organisation by forming itself some months later into a permanent commission, which in its turn gave birth to that famous body—the Automobile Club of France.

The contemplation of such successes in France could not leave public spirit in England entirely apathetic. In the summer of 1895 Mr. Evelyn Ellis, who had been using a 4 h.p. Panhard car in France, brought it over to England; and Sir David Salomons a little later imported a Peugeot car. In October, 1895, Sir David Salomons invited several members of Parliament and other people of influence and importance to a little demonstration of motor vehicles at Tunbridge Wells. This (the first motor show in England) consisted of Mr. Ellis's Panhard car, Sir D. Salomons's Peugeot, with a de Dion steam-car, and a petrol bicycle. To Sir D. Salomons and Mr. Evelyn Ellis belongs therefore the chief credit for the introduction of the modern motor-car into England. They both worked inde-

fatigably to convince people of the future that lay before this means of locomotion and in agitating for the removal of the ridiculous laws which restricted it. Their efforts approached success when Mr. Shaw Lefevre, as President of the Local Government Board, brought in a Bill to amend the law; but as a change of Government immediately followed the matter was dropped until the next year, when Mr. Henry Chaplin brought forward the Light Locomotives Act. On November 14th, 1896, this Act became law, and the day was celebrated by a run from London to Brighton, in which about twenty cars took part. The foundation of the *Autocar* by Mr. Henry Sturmey a year before had given the new movement its place in the English Press; the Daimler Motor Company was formed in February, 1896; a year later they had made and sold their first carriage, and the new era of road locomotion had dawned in England. But many valuable years had been lost, and British engineers began their contest in the motor-car industry with heavy handicaps.

We have now roughly traced the development of the idea of automobilism from its earliest beginning to the point at which it has now arrived. From the old wheeled chair worked by treadles, or from the clumsy and unpractical steam carriage of Trevithick, to the modern 40 h.p. touring car, with its low centre of gravity, its long wheel-base, its luxurious seats and armchairs, its light pneumatic tyres, and its admirably compact and silent engine, is a great advance; nevertheless, we may be quite sure that the motor-car is very far from perfection yet. On the day when a cheap, light, and compact means of storing a great power of electricity is discovered we shall see the last of the motor-car as we know it at present.

But that day may yet be some distance off. What has been accomplished is that we have now brought the science of automobilism on roads up to the point at which it exceeds our necessities. It is but a little while ago that no machine existed upon which we could travel on the roads as fast as we wished to travel; now we have machines which can travel faster than is either necessary, or desirable, or even safe. The next step is to bring the roads into such a condition that high speed can be used with safety to the travellers, and without danger or annoyance for those who still use the roads in the old and simple and pleasant way.

CHAPTER II

INDUSTRY AND SPORT

The difficulties of the beginner—The inevitable friend—Brass and paint—The modest advertiser—The Crystal Palace nightmare—Vicissitudes of a young industry—An old woman and her loaves—Popular fads—Every man his own fool—The Automobile Club—Motor racing—Police and the law—The International struggle.

THE amateur who proposes to buy his first motor-car finds himself launched into a stupefying atmosphere of rivalry, bewilderment, contradictory opinion, and opposite advice. At first the task which he has set himself seems a simple and pleasant one. He has a friend, perhaps, who owns a motor-car and is loud in its praises; why should he not get one of the same make? But the friend (who is perhaps an honest man) begins to search his conscience and to ask himself whether or not he is justified in recommending his own car. Since he bought it a dozen other makes have come under his notice, and with that restless passion for variety and novelty that always marks a movement still in the stage of development, his loyalty to his own type or make of car is already on the wane. So he furnishes the inquirer with the names of perhaps half a dozen other makes which at least are worth looking into. The inquirer goes in turn to the representatives of each of these six cars, each of whom in turn convinces him that perfection has been attained. Perhaps he puts one of the six cars out of his selection because he does not like the colour it is painted or the shape of its seats; and this, not improbably, is the best car of the number. But having almost decided to purchase the sixth (because it was the last one he saw), he mentions the fact to twelve separate acquaintances; who thereupon implore him to have nothing to do with the car in question and recommend

twelve other different makes of vehicle. Being enthusiastic motorists themselves they are passionate and disinterested in their solicitations, and, almost with tears in their eyes, try to dissuade him from this error which he is about to commit. And this is the only point upon which they are unanimous.

Our friend now perceives that the matter of choice is not a simple one, and that it behoves him to go warily, although his heart still remembers the sixth car with its shining brass and claret-coloured paint and its pretty device for keeping the cushions dry. He puts this weakness away from him, however, and goes home armed with five motoring papers, which he spends the evening in studying. He finds voluminous advertisement pages filled with what seem to his simple soul to be untruths, because on each page a different car is stated to be the fastest and finest that has ever been made. Each car has apparently won medals for "reliability" (the word is the curse of automobile literature); each is sold as cheaply as the maker (apparently a philanthropist) can manage without starving his wife and family; and each maker is eloquent of caution and warning with regard to other cars.

"Do not be deceived by external appearance," says the first, who perhaps has been unhappy in his attempts at graceful design. "Do you want an omnibus?" says the second. "If so, do not come to us. We have studied design and grace of appearance from the first, and wherever our cars go they are admired."

"The fastest car at the price," says the third. "One mile in seventy seconds. These figures speak for themselves." "We do not build a racing car," announces the fourth, "and our aim is not to shake our passengers to pieces. THE car for comfort." The fifth says, "Deeds speak louder than words. See our list of awards and prizes." "We do not believe in beating records and taking medals," says a sixth; "we know too much about how it is done. BUT ALL OUR CUSTOMERS ARE SATISFIED."

"Originality is our motto," says the seventh; "there is not a part of our car which has not been specially designed. Our machines are protected by twenty-seven of our own patents." And "Our car is not a freak," says the eighth; "we determined our lines five years ago, and have seen no cause to alter them. Ask our customers." And so on.

Our inquirer, not a little bewildered, turns to the correspondence pages, where he finds fourteen several correspondents, owning fourteen several makes of cars, asking for advice as to how they can avoid fourteen different kinds of breakdown from which they have each severally suffered. And in the private advertisements at the end of the paper he finds at least one representative, and sometimes a dozen, of every single make of car which he has seen or heard belauded advertised for sale by private contract at a ruinous sacrifice.

A sadly sobered person compared with him who lightheartedly made his first request for advice as to the purchase of a motor-car, our friend now pursues his way less hopefully. Every new acquaintance to whom he speaks adds to his embarrassment by naming new makes of car that he had never heard of before, until the area of choice expands alarmingly. Hopeless at last of being advised, he resolves to choose for himself, and attends an automobile show for that purpose. There his last remnant of sanity leaves him. Up and down the long gangways he walks with jaded steps and a splitting headache, Bleriot lamps goggling at him from a dozen directions, while keen-faced young men in square-cut morning-coats and very shiny hats convince him individually and in turn that each of them is selling the one and only car. Does he think they would be on that particular stand, they ask the inquirer derisively, if they were not convinced that they were selling a sound article? And they talk gears and clutches, ignition and lubrication, valves and frames to him until his ears buzz and his head throbs. He makes some faint attempt to grasp the individual characteristics of perhaps thirty different cars, and fails completely. Finally, perhaps, when he is thoroughly stupefied and exhausted, he is pounced upon by the dapper exponent of a dainty and glittering car, beside which is exhibited a chassis of marvellous ingenuity. The dapper exponent holds him there with his glittering eye; the wanderer cannot choose but hear. He listens, becomes interested, becomes convinced, and leaves the show having placed an order for a car only one model of which has ever been made, which has never been run, and perhaps could not run, and the clever and sanguine inventor of which, having risked all his little capital in his venture, becomes bankrupt a fortnight afterwards.

This, of course, is an extreme case, but it is not an unfair illustration of some of the difficulties and bewilderments that surround the sport and business of automobilism. The truth is that there has been and is an enormous amount of capital sunk in the motor-car industry in this country—a good half of it never to be recovered. And it is a curious fact that in England, the most conservative country in the world, capital can always be obtained for the exploiting of some new invention in a young industry such as that of automobilism, no matter how wild or impossible or unpractical the invention may be. Ideas that would be laughed at in France or America or Germany get a solemn trial in this country, with directors and registered offices complete. Probably it pays in the long run, but in the meantime it sorely embarrasses the trade as a whole. In the automobile industry there are dozens of firms undertaking to make cars who cannot by any possibility sell them at a profit. One of the conditions of success in this industry is that the manufacturer must be able to turn out, not two or three, but twenty or thirty cars a month; yet I think I am not wrong in saying that there are firms engaged in the automobile industry who could not turn out one car a month. Some of them, indeed, work on principles so bad that they suffer a loss on every car, and yet strain their powers to the utmost to sell as many as possible, as if by that means prosperity would be assured. One is reminded of the old woman whose loaves cost her twopence each to make, and who sold them at a penny three-farthings, saying, "It is only because I sell such an enormous number that I am able to live at all." Yet these firms, who contribute nothing to their own prosperity or that of the industry, embarrass the private purchaser by their advertisements, and add to the already enormous list of cars offered for his choice.

Such a state of affairs cannot last, but there will be much loss of money and many bankruptcies before it is over. In the meantime a further difficulty is presented by the fact that while a motor-car is a highly complicated machine, demanding considerable technical knowledge on the part of anyone attempting to appraise or criticise it, it is sold to persons with no technical knowledge whatever, and yet who not unnaturally wish to exercise their choice in the purchase of it. One result of this

is that certain fads in connection with motor-cars come for a time into such prominence that every motorist demands that his car shall be furnished with the particular thing which is most fashionable at the moment, although he may be quite incapable of judging how far its popularity is justified. Among such matters I may mention honeycomb radiators and the direct drive on the top speed. Another example is to be found in the method of cooling engines by water instead of air. Messrs. Lanchester, who, almost alone among the principal makers of motor-cars, retained air-cooling on their engines, retained it because they believed it to be simpler than and just as efficient as water cooling. They found, however, that they were losing business because of the almost universal demand for a water-cooled engine, and they are therefore now fitting water-cooled engines, not because they think them necessary, but because their customers, who have certainly given the subject much less study than the makers themselves have given to it, think them necessary. I do not say anything about the merits of these popular tastes; the public may be right and it may be wrong; but it is unfortunate that engineers who are working at an industry which has not reached its full stage of development should be compelled to adapt their practice to popular and uninstructed requirements. It is, of course, absurd that an amateur who wishes to spend £500 on a piece of complicated machinery, of which there are dozens of types, the different qualities of which he is incapable of estimating, should make his purchase without expert advice. But every man claims the right to be his own fool; and in the matter of motor-cars he has this much on his side, that there is not as yet a sufficient number of disinterested experts whose services are available for this purpose. The honesty and disinterestedness of the expert must, of course, be beyond question, and this is impossible so long as he receives, or is suspected of receiving, a commission from the makers of the cars which he sells. I believe there are one or two experts who refuse to receive any commission from manufacturers or agents, and who are thus wholly in the service of the purchaser; but there will have to be many more of such men, and they will have to be much better known than they are at present, before either they will be able to make a sufficient income from their consultation fees, or the public will

and luck, but are trials also of brain, judgment, and endurance, as well as trials and tests of machinery, material, and design.

The law with regard to motoring, although—thanks to the strenuous efforts of the Parliamentary automobilists—it has been recently amended, still acts as a hindrance, an injustice, and a persecution to motorists. True, the state of affairs is largely due to the selfishness and vulgarity of some among their own number; but that is little consolation to the decent and respectable. I am inclined to think, however, that it is not so much the law that is at fault as the spirit in which it is applied. In too many cases this is a punitive and spiteful spirit. The object of the law, with which we are all in sympathy, is the protection of the public. Yet how do the police as a body act in applying it? Do they use every effort to discourage excessive speed on the part of the individual motorist? On the contrary, they use every subterfuge to tempt and entrap him into excessive speed. Their object is not to prevent him from breaking the law, but to induce him to do so; hence their traps on empty and tempting stretches of road, where speed is not dangerous at all. If the police were seen about the roads, no motorist would dare to drive at an excessive speed; but when they hide behind hedges, they are acting merely as spies and not as constables of the public safety. This "hedging and ditching" policy, apart from its injustice, is a discredit to, and a blot upon, the traditions of the English police.

There remains the vexed question as to how far the English automobile industry has come up to its French and German rivals. One would like to be able to say that in every respect the English trade can compete successfully with the foreign trade; but anyone who is at all informed upon these matters knows that it has not yet quite reached that point. We can and do make in England many motor-cars which for all practical purposes are as good as anything that can be bought elsewhere; but it is not true that we can make any and every part of a motor-car better and cheaper than it can be made abroad. But we have crept up very fast on our rivals, and I make no doubt that in a few years we shall have passed them, when we have had enough experience to wipe out the advantage which they gained by several years' start of us. The Mercédès and the Panhard cars still remain the ideal cars of the man to whom

money is no object. They represent in that sense of the word the best that has yet been both achieved and proved in the building of motor-cars. Yet there are cars in England to-day fully their equals in excellence of design to which time—that alone can make a just award in these matters—may transfer the crown which as yet adorns alien brows. The truest patriotism in these matters is to design and build a car in England of the best materials, wherever they may come from, and to equip it with the best inventions, in whatever nationality they may have been born. By that means alone are we able to know what the best is and in time to surpass it.

CHAPTER III

THE PETROL MOTOR AND ITS CONNECTIONS

The first step—The Otto system—Carburettors—The fly in petrol—Valve gear—Ignition—The Magneto system—Silence and power—Air and water cooling—Transmission and control—Increased elasticity of the petrol engine—Fashions in design—British ingenuity—The clutch and its work—Gears and gearing—Change-speed mechanism—The differential gear—The Crypto gear—The petrol electric system—Brakes and steering.

THE first step towards the understanding of a petrol motor-car by the amateur is the understanding of the petrol engine. Though it forms only one part, it is the most vital and intricate part of the machine; and whether the amateur drives his own car or not, it is of the first importance that he should understand its mechanism. For one thing, it is a stupid and uninteresting thing to be driven about in a vehicle without knowing how it is propelled; and for another, a knowledge of the mechanism of the motor-car will save its owner much money.

The type of petrol engine used on modern motor-cars consists in its simplest form of a single cylinder closed at the top and open at the bottom, within which a closely fitting piston connected by a swinging rod to the crank shaft moves up and down. The motive power is derived from a mixture of air with the vapour given off by petroleum spirit. This mixture is introduced into the cylinder itself, and when the piston is at the top of the cylinder, forms a cushion of gas between the fixed cylinder-top and the movable piston. The gas is then ignited, and by the heat thus instantaneously generated is enormously expanded, forming, in fact, an explosion. As the piston is the only thing that can give way, it is by this explosive force driven to the bottom of the cylinder,

where its further downward movement is arrested by the crank. As the piston must be gas-tight, it is first made a free sliding fit in the cylinder; three or four parallel grooves are then cut in its circumference, and into these grooves are sprung cast-iron rings, the circumference of which is slightly larger than that of the cylinder and very slightly eccentric to it. The impulse of the explosive stroke is stored in a fly-wheel attached to the crank shaft, which is carried round again and drives the piston up. These are the broad movements, a repetition of which maintains mechanical energy.

In the Otto cycle, however, which is employed in all motor-car engines, there is only one explosion to four strokes of the engine. These are termed respectively the Suction stroke, the Compression stroke, the Explosion stroke, and the Exhaust stroke. To describe them properly in detail we must suppose the engine to be running.

(1) The Suction Stroke.—The piston is at the top of its stroke, and the combustion chamber (as the space between the top of the cylinder and the piston is called) is empty of gas. As the fly-wheel revolves it begins to pull the piston down, and a partial vacuum is thus created in the combustion chamber. This chamber has two valves opening into it—the INLET valve and the EXHAUST valve. As the piston travels down the suction caused by it opens the Inlet valve, and the combustible mixture rushes in and fills the cylinder. The Inlet valve may be opened either by the suction of the piston or by mechanism, but in either case the effect is the same. So that the Suction stroke brings the piston to the bottom of the cylinder, which is at the same time filled with gas.

(2) The Compression Stroke.—The piston being at the bottom of its stroke and the cylinder filled with gas, the travel of the fly-wheel carrying the crank round begins to thrust the piston up again. The moment it begins to do so the Inlet valve closes, so that the gas is imprisoned in the cylinder. The piston fits the cylinder tightly, this fit being maintained by the piston rings already described, which are prevented from sliding round on the piston by means of pins fixed in the grooves between the open ends of each ring. As the piston rises it compresses the gas, which has no means of escape, and by the time it has reached the top the combustion chamber is filled

with inflammable mixture in a high state of compression—a state which is necessary if the proper explosive force is to be derived from ignition.

(3) The Explosive Stroke.—When the piston is at the top of its stroke the mixture is ignited by electricity or some other means, and its expansion or explosion drives down the piston with great force, which, being stored in the fly-wheel, thus furnishes energy enough for the three strokes in which there is no impulse, as well as for the purpose of driving the car. The piston is now once more at the bottom of its stroke.

(4) The Exhaust Stroke.—As the fly-wheel, refreshed by the impulse imparted to it by the Explosion stroke, thrusts the piston up again, the Exhaust valve is opened by a mechanical arrangement of cams and rods, and this allows the burnt gas to be driven by the ascending piston out of the cylinder. As the piston reaches the top of the stroke the Exhaust valve is closed, and the cycle of operations begins again with the suction stroke. The accompanying illustrations show the complete cycle, from which it will be seen that the fly-wheel (or crank shaft) makes half a revolution for each stroke of the piston, and it therefore makes two complete revolutions for every explosion.

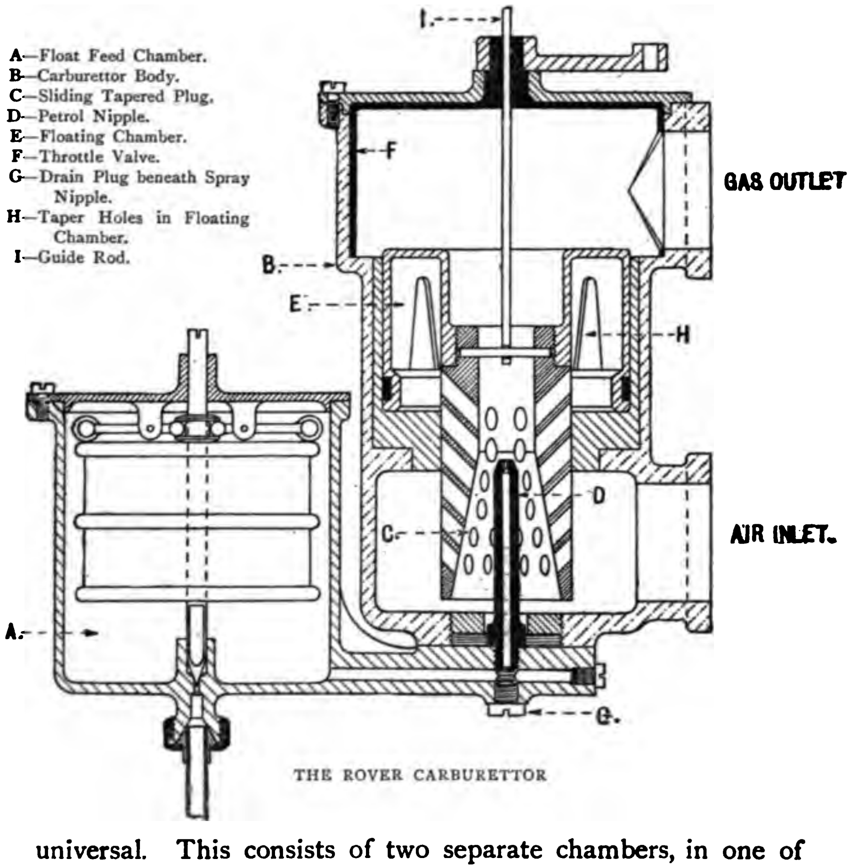
This, then, is the actual working of the petrol motor, which should be easily understood from a careful study of the accompanying plates, for the use of which I am indebted to the *Autocar.* In practice, however, it is a far less simple affair than would appear from my description, and consists of many more parts than have been so far named. It is now comparatively unusual to build motor-cars with a single-cylinder engine; two or four are the commonest numbers, and engines with three, six, and eight cylinders are also built; and although in each cylinder the same process is going on, an increase in the number of cylinders involves considerable complications, as the Inlet and Outlet valves, and the mechanism for working them, are increased in proportion. I will now describe some of the principal accessory parts of the petrol motor.

The first of these is the CARBURETTOR, as the chamber in which the petrol is vaporised and mixed with air is called. The chief advantage derived from the use of petrol or petroleum spirit as an explosive agent is the readiness with which it vaporises. Petrol exposed to the air at any time will give off an

inflammable vapour, so that a comparatively simple apparatus is necessary to ensure a sufficient supply of this vapour to the engine. In its most elementary form the Carburettor consists of a box or chamber partly filled with petroleum spirit. In the top of this chamber a tap is fixed, which controls the supply of vapour to the engine. There is also an inlet for air, which ensures a sufficient admixture with the spirit, and this also is controlled by a tap. There are two broad types of Carburettor in general use, and although almost every maker has modifications of his own, nearly all Carburettors fall into one of these two classes: Surface Carburettors or Spray Carburettors; but the surface type is gradually disappearing. It is most simply understood in the original de Dion form, which was designed for use on motor-cycles. Here a rectangular metal chamber was kept about half full of petrol; a vertical pipe passing through the wall of the chamber admitted air to the petrol itself, the lower end of the pipe being submerged under the liquid for that purpose. Over the surface of the liquid, but not quite reaching to the sides of the chamber, a metal plate was fixed so that the vapour rising from the surface of the petrol was directed towards the top and sides of the chamber. The plate also prevented the petrol from splashing up into the tap, so that at the top of the chamber, which answered the purpose of the steam dome of a locomotive engine, there was always a supply of vapour. Outside the chamber was fixed a twin valve with two openings, one communicating with the atmosphere, and another with the pipe which supplied the engine; so that the quality as well as the quantity of the mixture was thus regulated. A pipe led from the exhaust of the engine through the Carburettor; and this, by warming the petrol (the exhaust gases being extremely hot), rendered its vaporisation more rapid.

This form of Carburettor was found to work well with little engines using a comparatively small amount of vapour and working at a constant speed. Its disadvantage is that when the engine is run at a high speed the air is drawn so rapidly through the Carburettor that it has not time to become sufficiently impregnated with the vapour from the spirit. There is, moreover, a certain waste in the petrol itself, owing to the fact that it becomes gradually impoverished until what remains in the Carburettor becomes too weak to furnish sufficient vapour.

Another form of Carburettor, therefore, had to be devised which should be more constant and regular in its working, and which should provide for an economical use of all the combustible constituents of the petrol. These results are achieved more or less absolutely in the various forms of the apparatus known as the Spray Carburettor, the use of which is becoming



THE ROVER CARBURETTOR

universal. This consists of two separate chambers, in one of which the liquid is maintained at a constant level by the use of a float controlling the supply valve, while in the other the actual vaporising and mixing with air takes place. The petrol enters the vaporising chamber through a pipe with a very fine nozzle, which either sprays the liquid on to a cone and thus breaks it up into vapour, or it is led through a very fine rose. The second

chamber is thus filled with a fine mist or spray; and the necessary amount of air is drawn in with it to ensure a proper mixture. The action of these Carburettors takes place at each suction stroke of the engine, when the vacuum caused in the combustion chamber makes the petrol spurt out through the nozzle into the mixing chamber, whence it is drawn into the cylinder. In the Longuemare Carburettor the vaporising chamber is warmed by being surrounded with a jacket, into which the hot gases from the exhaust are introduced.

As I have said, there are a great many varieties of Carburettor, but they vary only in small details with which the amateur need not concern himself. In the Lanchester, for example, the petrol is drawn from the tank by the capillary attraction of wicks, which give it off in the form of vapour. But in principle nearly all Carburettors are constructed on one or other of the plans described. Almost the only disadvantage of the spray type of Carburettor is that unless the petrol is very carefully filtered the jet or nozzle is apt to become choked, when of course no vapour can reach the engine. Thus a fly or a grain of dirt in a Carburettor would be enough to stop a 90 h.p. motor-car, and unless the motorist is very wide-awake it may take him a long time to find the cause. There is a possibility also of the float which controls the supply becoming stuck to the sides of the chamber; but the drawbacks of this are avoided by a common arrangement whereby the stem of the supply valve is continued through the float and out beyond the wall of the chamber, where a touch of the fingers before starting up the engine will ensure its being in proper working order. The prime necessity of a Carburettor is that it should be perfectly automatic in its working. It is, in fact, the most vital and delicate part of the petrol motor, and its absolute sensitiveness to the conditions existing within the cylinder or cylinders of the engine is a *sine qua non* for the sure and silent and economic working of the machine. The faster an engine works, the more air is needed in the mixture; and it is to the invention of a mechanism which will be perfectly automatic in regulating the quality of this mixture in accordance with the speed of the engine that the principal efforts of designers have latterly been directed in the construction of Carburettors. No small part of the silent and perfect running of a Mercédès engine, even at a very low speed, is due to the form

of Carburettor employed. In the detailed accounts of special motor-cars some of the different forms of Carburettor will be more particularly described; in particular, that used on the Crossley car, which is one of the latest, will be found specially interesting. The broad description which I have just given will, I hope, be enough to enable the reader to understand the more full and technical details which accompany the illustrations of the Carburettors on some modern motor-cars.

We will now consider the two valves which govern the admission of gas to the cylinder and the expulsion of burnt vapour from it, called the INLET valve and the EXHAUST valve respectively. The Inlet valve was until quite recently almost universally opened merely by the suction of the descending piston, and thrust back to its seat by a spring. But as the work in petrol engines became finer and the adjustment more exact, it was found that the opening of the Inlet valve by these means was not sufficiently accurate, either as regards the extent to which it was opened or the time during which it remained open. Mechanism was therefore devised for opening it at a given moment in the stroke of the piston; and these mechanically operated Inlet valves, although they were for a time regarded as novelties, are now used in nearly all but the very smallest and simplest engines, and in some types of racing car, such as the Napier, where multiple-seated automatic valves are used.

It will be remembered that only one explosion takes place for two revolutions of the fly-wheel, which is attached to the main crank shaft. For the purpose of operating the Inlet and Exhaust valves, therefore, a second shaft, called the half-time shaft, is connected by gear wheels to the main crank shaft, the gearing being so proportioned that it revolves only once while the main shaft revolves twice. Both valves consist of a disc with a bevelled surface fitting into a circular opening which leads into the combustion chamber. Through this disc a stem projects downwards and rests on the top of a rod placed in such a position that the lower end of it is thrust up by the projecting part of a cam fixed on the half-time shaft and falls down again every time the half-time shaft revolves. Every time this rod is thrust up by the cam it pushes up the valve and holds it open until the projection of the cam, passing from under it, allows it to drop again, when the valve seats itself by means of a powerful

spring. With every revolution of the half-time shaft this operation is repeated, so that the Inlet and Exhaust valves are opened and closed once for every two revolutions of the fly-wheel. The two valves are similar in construction, but the cams which work them are set in opposite positions on the half-time shaft, so that the Inlet valve is open only during the induction stroke of the engine, and the Exhaust valve only during the Exhaust stroke. As a matter of practice the cam of the Exhaust valve is so set as to open the valve just before the beginning of the Exhaust stroke, so that the back-pressure that would otherwise be caused by a cylinder full of gas is avoided.

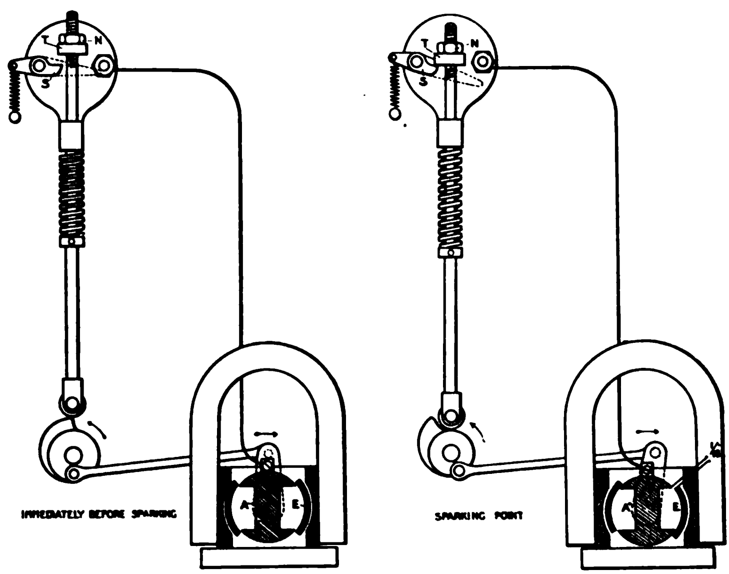
The arrangements for firing the charge of compressed gas may be grouped under the head of IGNITION. It was formerly the practice to ignite the charge by means of a platinum tube pierced through the wall of the cylinder, its outer end being set in the flame of a spirit lamp, so that as the piston rose in the compression stroke, the inflammable vapour was forced to the outer end of the tube and became ignited. This, however, was a clumsy and withal a dangerous method. The heating of the platinum tube often caused premature firing or back-firing when the engine was running at a high speed, and the presence of a lighted flame in the neighbourhood of a store of petrol was a fruitful cause of fires, and has in its time compassed the destruction of many a motor-car. This method of ignition, called Tube Ignition, has now been abandoned in favour of Electric Ignition, of which there are two principal forms in common use.

In the first of these, High-Tension Electric Ignition, the firing is caused by an electric spark jumping across a gap within the combustion chamber itself once during every four revolutions of the fly-wheel; and it is so arranged that the time of the spark can be varied by the person driving the car, who can thus cause the explosion to take place at an earlier or later point in the explosion stroke. To produce a spark in the highly compressed atmosphere of the combustion chamber a greater tension of electricity is required than is supplied by the ordinary battery or accumulator; the current is therefore sent through an Induction Coil, in which is induced a high-frequency current of much greater strength than that given out by the battery or accumulator from which the electricity is derived. A device

known as a Commutator is in this system employed to convey the electric current, making and breaking contact, and thus producing the sparks in the combustion chamber at the right moment. The simplest and best form of commutator used in connection with ignition for petrol motors is an insulated hollow drum with four contact segments or pieces of metal, which are let into the insulated ring at equal intervals, and to which are attached terminals from which the current is conveyed by wires attached to the different cylinders. The commutator ring is placed immediately over the two to one shaft, and attached to the shaft is a brush contact which, when the shaft is in motion, passes round the inside of the commutator ring, and makes an electric circuit every time it passes one of the metal contacts, and thus a current of electricity is conveyed to the sparking plug in each cylinder at the right period. A mechanical connection from the driver's seat enables the position of the commutator so to be altered that the firing takes place a little earlier or a little later in each stroke as may be desired—the process known as advancing or retarding the spark. For the provision of a suitable spark in the cylinder the wire is attached to what is known as a sparking plug. This is a small metal plug screwed into the top of the combustion chamber. It contains a core of mica or porcelain or other non-conducting material through which the wire is led, the end of the wire terminating in a platinum point fixed in close proximity to another platinum point connected directly with the metal of the engine and car which forms the "earth" connection. It is across the gap between these two platinum points that the igniting spark jumps. The disadvantages of the high-tension system, however, are many, not the least being the risk of short-circuiting the current and the necessity for re-charging the batteries regularly.

The most popular form of ignition, and that which is being adopted on nearly all but the very smallest petrol cars, is the Low-Tension Magneto System, in which batteries and accumulators are done away with, and the car supplies its own electricity while running. The source of electricity is a magneto machine which consists of two or three permanent magnets of the ordinary horse-shoe shape which are mounted on a bronze plate. An H-shaped armature is fixed between the poles of the

magnets; it is wound with insulated copper wire connected at one end to a terminal and at the other to the core itself. Between the armature and the poles of the magnet is mounted an oscillating shield of soft iron. This shield is in the form of two curved pieces connected at the ends and mounted on pivots, and it receives its oscillating movement from a cam on the half-time shaft. These oscillations of the shield produce an intermittent current in the wire surrounding the armature. The spark is produced in the cylinder by means of an insulated pin mounted in the wall of the cylinder itself, this pin being



SIMMS-BOSCH MAGNETO SYSTEM

connected to the terminal of the armature. A light spring mechanism carries what is called an "interrupter" arm, which normally rests against the insulated pin and forms an electric contact with it, but which, by means of the movement of the cam on the half-time shaft, is moved momentarily out of contact with the pin once in every revolution of the cam, and thus produces a spark in the cylinder. The system which is here illustrated by a diagram is the Simms-Bosch system, and is the simplest of the magneto devices. There are many varieties, but the working principle is practically the same in all cases.

The alteration in the timing of the spark is effected by the helical movement of a sleeve mounted on the cam shaft.

High-Tension Magneto Ignition is a development of the low-tension system; in this case the magneto machine merely takes the place of accumulators, and the low-tension current thus produced is sent through an induction coil and fires through sparking-plugs, just as in the ordinary high-tension system.

The SILENCING of petrol motors is an important matter, which was formerly very inefficiently provided for. The explosions of the engine and the emission of the exhaust gases would, if there were a direct passage to the atmosphere, cause an extremely loud noise, such as is heard on racing cars which have no silencing arrangements. To confine the exhaust gases, however, would lead to back pressure on the engine and consequent diminution of power; and the problem of silencing has been to reduce the sound of the exhaust to a minimum and to retain the maximum of power given off by the engine. This is achieved by various devices, the common principle of which is that the exhaust gases are passed into a chamber or series of chambers of greater dimensions than the exhaust pipe itself. These chambers are perforated, so that the exploded charge passes from one to the other and is gradually broken up and distributed to the atmosphere.

There are various methods of governing the running of the engine automatically so that, for example, when the load is withdrawn from it it shall not suddenly develop an excessive speed. In its commonest form the action of the GOVERNOR is centrifugal. Its movement, after a certain engine speed has been exceeded, serves to cut off the supply of vapour to the engine by means of a throttle fixed in the supply pipe. This system is known as "governing on the throttle." Or it may act so as to govern the opening of the inlet valves, thus permitting more or less gas to enter the cylinders; this is known as "governing on the inlet"; or in the third system the movement of the governor may be applied to the exhaust valves, restricting their opening so that the exhaust gases do not escape from the cylinder and therefore prevent the opening of the inlet valve during the suction-stroke. But this system, known as "governing on the exhaust," is seldom employed

except where the inlet valves are operated by the suction of the piston, and not by mechanism. In cases where an additional speed of the engine is required to that for which the governor is set, the speed can be increased by means of a pedal which prevents the governor from acting. This device is known as the "accelerator."

The cooling of the petrol engine is generally effected in one of three ways. The great heat developed inside the cylinder by the rapid movements of the engine would soon cause the piston to seize or bind if it were not kept within limits; moreover, it would decompose the lubricating oil and cause oxidisation of the valves. In almost all cases the engine is adapted to be cooled by the atmosphere, which acts either through the medium of water or directly on the cylinder itself. Only in small engines, however, such as those employed on motor-bicycles, is this second method satisfactory; and it is then only feasible while the vehicle is running and producing a current of air against the cylinder. When the vehicle is stationary, or travelling slowly up a hill with the engine exerting considerable force, there is great danger of overheating. In these engines, which are cooled by direct contact with the atmosphere and are known as "air-cooled engines," the cylinder is fitted with webs or rings for the purpose of increasing the area of metal exposed to the cooling agent, and the engine is placed so that it receives a free current of air while the vehicle is travelling. The only large motor-car engine which is still cooled by direct contact with the atmosphere is the Lanchester, in one form of which a cool condition is maintained by currents of air drawn in by friction-driven fans to a space surrounding the engine.

In the second method of cooling, water is interposed as a medium between the atmosphere and the engine. A tank is fitted containing a supply of water, and the cylinders are encased with a covering which leaves a space for water round the cylinders, and is known as a "water-jacket." The water passes from the tank into the water-jacket, where it absorbs the heat given off by the engine. It is then passed out at or near boiling point to a radiator fixed in front of the car. The radiator consists in one form of a long metal tube bent backwards and forwards upon itself, upon which metal flanges are

closely threaded; and in its progress through this tube or series of tubes the water becomes cooled, until it is returned to the tank with its temperature sufficiently reduced for it to be passed on again to the water-jacket for the purpose of absorbing the heat developed by the engine. Thus circulation is maintained either by a centrifugal pump driven by a chain off the engine shaft, or, automatically, by means of what is known as the "Thermo-Syphon" system, in which advantage is taken of the fact that hot water rises to the top of a tank and cold water sinks to the bottom. The third system, which was introduced by the Mercédès firm, and has since become more and more common, is a combination of the two methods described above. In this case the front of the car consists of a water-tank pierced like a honeycomb throughout its whole surface with apertures of equal dimensions; this is known as a "honeycomb radiator." At the rear of this is placed a fan which draws the air through the holes in the tank, and thus cools the water contained in it, even when the car is standing still. In the Mercédès cars the fly-wheel acts as a fan, its surface being shaped into vanes for that purpose; and in some cars both fan and fly-wheel are used to draw in the air. The water from the tank is circulated through water-jackets on the engine in the usual way; but in addition the current of air induced by the fan helps, by playing round the cylinders, to keep them cool.

As the petrol engine, unlike the steam engine, is incapable of starting itself, means are provided for starting it by hand, and afterwards for coupling it by means of a clutch with the work which it has to do. For this purpose a handle is fitted to the forward end of the crank shaft. It engages with and turns the crank shaft until the engine begins to work, when it is released. With this handle are given to the engine the first two or three turns necessary to produce the initial strokes of suction and compression; and the inflammable charge thus produced being ignited automatically, the engine starts. So fine has the work in motor-car engineering become, however, and so accurately are the valves and pistons fitted, that in many four- or six-cylinder engines the compression is retained for many hours after the engine has been stopped; so that all that is necessary is to switch on the ignition, and so fire the cylinder or cylinders in which the compressed gas has been retained.

TRANSMISSION AND CONTROL

The transmission of the power generated in a petrol motor to the wheels of the car is far from being the simple problem that it might appear. Although rotary motion is produced in the engine and rotary motion is desired in the wheels, the direct coupling of the two together is for many reasons impossible. For one thing, direct coupling means that the speed of the motor is similar to the speed of the road wheels; and although this is a simple enough matter in a steam engine, the speed of which can be varied merely by the admission of more or less steam to the cylinder, the fact that the petrol motor runs at what is virtually a constant speed makes any such method impossible. It must also be remembered that if the motor runs only at the same speed as the road wheels it must be of much greater size, in order to develop the necessary power, than if it is run at a greater speed. Within certain limits, indeed, speed in a petrol engine may be regarded as a substitute for size, and, still within defined limits, the area of the piston surface may be reduced in proportion as the speed at which the pistons are driven is increased. And as size and weight are things to be avoided as far as possible in the component parts of a motor-car, it is customary to develop the necessary horse-power in a small engine which is run at very high speed, the speed being much reduced in the course of its transmission to the road wheels.

These conditions have, in the last year or two, been considerably modified by the increased range of speed imparted to the petrol motor by niceties and improvements in the carburettor. At the same time an increase in the number of cylinders used in a single engine has assisted to the same end, and there have actually been cars constructed, the engines of which were composed of eight cylinders, in which no gearing down has been employed, the whole of the changes of speed in the car being effected by corresponding variations in the speed of the motor. The immense complication of the engine, ignition, and valve gear in such a case, however, prevents its practical application to the purposes of ordinary motor-cars, and it can only be regarded as an interesting experiment. The most usual practice in the construction of petrol-driven motor-cars is to place a

high-speed petrol motor in front of the car, where it is protected by a bonnet, and to drive the rear wheels by means of chains and gearing. This is very far from being a mechanically ideal method; it places the engine at the farthest possible point from its work, and at the same time causes the absorption of from 30 to 60 per cent. of its power in the transmission gearing, so that sometimes only a small proportion of the power given off by the engine is delivered at the rim of the road wheels. Nevertheless, considerations of mechanical convenience seem to have united most designers in agreement that, under the existing systems of transmission, this is the best solution of the problem of construction.

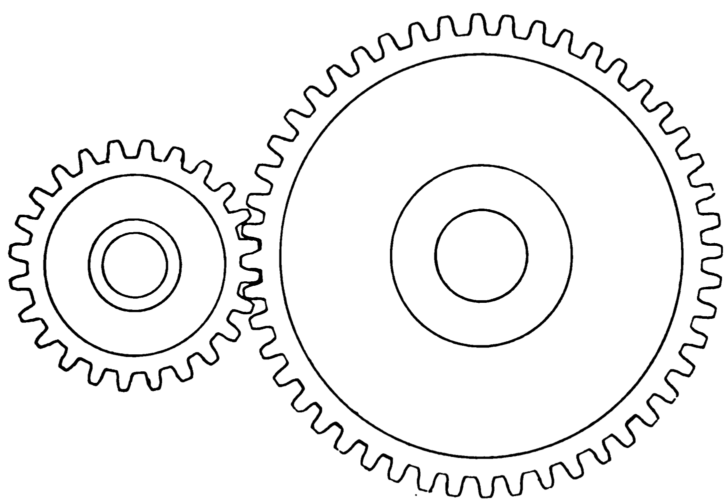
In such cars as the Duryea and the Lanchester very great ingenuity has been directed towards the securing of a more ideal design; certainly such a system as that of the Lanchester, in which the engine is placed in the middle of the car, is more rational and mechanically sound than any other. But it is only really satisfactory with an engine of a perfectly balanced type such as the Lanchester; indeed, a feature of the Lanchester car is that originality in one part of the design has involved originality in another, and that each part of the car has had to be logically thought out in order to justify and make good what has gone before. Moreover, it is not too much to say that the Lanchester car would hardly be possible if it were not for the brilliant ingenuity and mechanical beauty of the system of suspension employed, which solves the steering problem as well as the difficulties involved by the central position of the engine.

The usual practice, however, is the less perfect one already described, which is not without solid advantages. The forward position of the engine makes cooling a comparatively easy matter, as not only the radiator but the engine itself receives the full cooling effect of the wind caused by the travel of the car. It is also easily accessible and, being in a position entirely isolated from the passenger part of the carriage, does not cause dirt and untidiness where these can least be tolerated. The control of the engine is also somewhat simplified, and it is readily exposed for the purposes of adjustment. By far the greater number of makers place the engine vertically in this position, the crank shaft being situated longitudinally beneath the car. Immediately behind the engine is situated a device

by which it can be mechanically coupled and uncoupled to its work of driving the car. This is necessary because, as the engine has to be started by hand, it would be inconvenient to stop it every time it was required to stop the car momentarily and to alight and start it up again. This mechanism is known as the clutch, and is generally of the kind known as a friction clutch. On the rear end of the crank axle is fixed the fly-wheel, the rear face of which is shaped as a large and very flat hollow cone. The transmission shaft, which is to be coupled to it, lies in line and concentric with it, the forward end of this shaft terminating in another cone which can, by means of a sliding sleeve on the transmission shaft, be made to engage with the hollow or outer cone on the crank shaft. One or other of the surfaces is in many cases covered with leather or with fibre, and the friction produced by the pressing of the one cone within the other causes them to revolve together, so that the motion of the crank shaft is thus transmitted. The two cones are normally held in engagement by a powerful spring, which can be compressed by the pressure of a pedal and the male cone thus withdrawn. Another form of clutch, which is much used on some of the larger and heavier makes of car, is an expanding ring or drum, which, when it is not desired to transmit motion, remains stationary within a non-expanding ring attached to the fly-wheel, or forming part of it. When it is desired to communicate the motion of the fly-wheel to the gear shaft the release of a pedal causes the inner ring to expand and its circumference to grip that of the inside rim of the fly-wheel. A magnetic clutch has also been devised, in which an electric current is caused to produce a magnetic contact between the two portions of the clutch; but this is not a usual method. Another form of clutch is brought into action by means of a coil spring, the principle being that when the clutch pedal is depressed it makes a connection between the clutch and a very strong steel coil mounted on the shaft upon which the clutch slides, and so causes the wire coil to be wound up so that the motion of the fly-wheel is transmitted. But it will be seen that the principle common to all clutches is the engagement or disengagement of two concentric and parallel revolving surfaces.

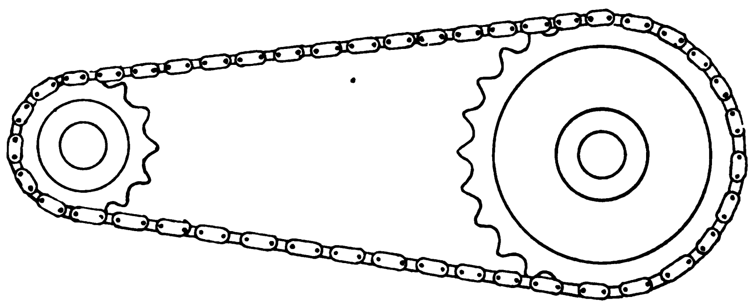
It is not enough, however, to gear the transmission shaft, thus

brought into contact with the crank shaft directly, to the road wheels; for then the car (provided the speed of the motor was constant) would only be able to travel at one rate of speed. Changes of speed in the car have therefore to be provided for by different sets of gearing, by means of which the gear shaft transmits its motion to the road wheels in different ratios. The usual way of accomplishing this is by means of gear wheels, the principle of which may be easily understood from the familiar working of one cogged or toothed wheel in another. If two cogged wheels of equal sizes are placed in mesh and one of them



is revolved, the other will be revolved at equal speed, but in an opposite direction. If a third cogged wheel of equal size be interposed between them, the original two will then revolve in the same direction. If one cogged wheel be revolved in mesh with another of twice the diameter, the large wheel will turn round at only half the speed of the small one—that is to say, that if one of them has ten teeth and the other twenty, the wheel with ten teeth will make a complete revolution while the wheel with twenty teeth makes only half a revolution. It will now be seen that, given wheels with teeth of equal size, the diameter of each wheel may be varied indefinitely with a corresponding variation in the speed transmitted. If the

driving wheels are of smaller size than the driven wheels, the speed will be reduced in transmission, but if the driving wheels are larger than the driven wheels, the speed will be increased in transmission. The first method is known as gearing down, and requires the exertion of less force in the motor; and the second is known as gearing up, and requires the motor to exert more force per revolution for the performance of an equal amount of work. The same effect is produced if, instead of two toothed wheels moving in engagement with an intermediate wheel, they are connected by a chain, the links of which pass over the teeth on the wheels.



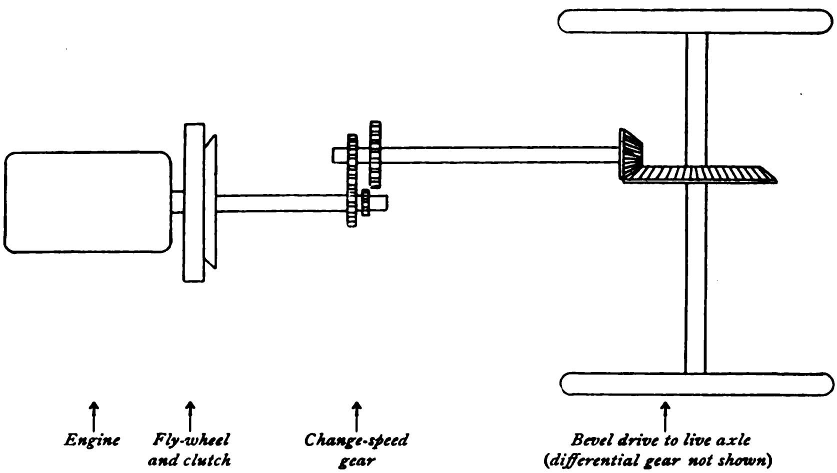
In the application of this principle to the driving of motor-cars the gear shaft is fitted with a number of toothed wheels of different sizes, in accordance with the number of speeds at which it is proposed to drive the car. If there are three speeds and a reverse there will be three toothed wheels of different sizes keyed on to this shaft. Parallel with it, and in the same horizontal plane, lies another shaft called the secondary shaft, and on this there will also be three toothed wheels of different sizes. Mechanism is supplied for sliding these wheels into various positions on the shafts, so that different wheels on each shaft can be brought into mesh. Thus, when the smallest wheel on the gear shaft is in mesh with the largest wheel on the secondary shaft, the car will be on its first or lowest speed. To obtain a reverse movement a cogged wheel is introduced into mesh between two wheels on the different shafts, so that the motion of the secondary shaft is thus reversed. This is the change-speed gear in its simplest and commonest form, but in detail it contains an almost infinite number of varia-

tions, some of which will be found described in the following chapter.

Before considering the remainder of the transmission, *i.e.* from the secondary shaft to the road wheels, we must notice a difference that exists between vehicles which drive themselves and those which are drawn behind horses or other tractors. When an ordinary horse-drawn carriage is turning a sharp corner it will be noticed that the near wheel is almost stationary, while the wheel on the outside of the curve revolves at considerable speed. This is simply because each wheel is revolving independently upon the axle. But if, as in the case of motor-cars or locomotive engines, the axle itself is what drives the wheels, they no longer revolve upon it, but are keyed positively to it and revolve with it. With this arrangement it is impossible for one wheel to revolve faster than the other, and therefore in going round the curve the inside wheel, to accommodate itself to the rate of speed imparted to the outside wheel, would have to be thrust sideways upon the road. In locomotive engines and carriages with "live" or revolving axles, this side play is extremely small owing to the large radius of the curves employed; and the small amount of play necessary is allowed for by the flanges of the wheels being an inch or two nearer together than the inside edges of the rails. In tram-cars where the radius of curve is often necessarily smaller, the amount of play required is not possible; and if you will go and examine the lines of any tramway on a sharp curve, you will see the inside rail all polished and worn away with the grinding and slipping action of the inside wheel.

In a motor-car, however, which travels at high speeds and round far sharper curves than those of tramways or railways, wheels rigidly connected by a revolving axle would soon be destroyed by the dragging strains of the radial action developed in turning. The device known as the "differential gear" has therefore been designed to allow each wheel, or rather each half of the live axle, to turn at a greater or less speed than the other. This device consists of the division of the axle in or near the middle of its length by a gap large enough to admit the wheels of the differential gear. To the centre end of each of the two axles formed by this division is keyed a bevel wheel, the two wheels having their bevelled surfaces facing each other,

but with a space between them. In this space there runs a plain wheel, which is free to revolve about the axle; it carries mounted upon it three pinions, all of which are engaged with the two bevel wheels on either side. The wheel carrying the pinions receives the driving impulse either by means of a chain or a bevel gear, and as it revolves it carries round with it the small pinions, which in their turn drive the bevel wheels keyed to the axles. But if either of these wheels should meet with an obstruction, or if in turning one of them should be required to make more revolutions than the other, the pinions would them-

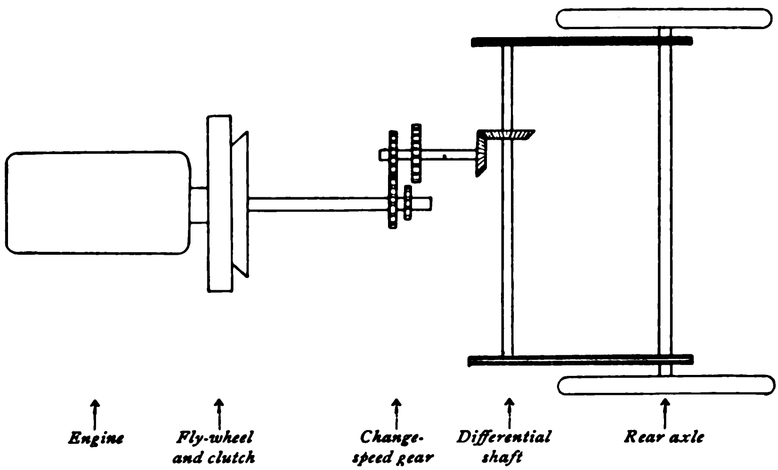


SKETCH ILLUSTRATING TRANSMISSION THROUGH LIVE REAR AXLE

selves revolve about their axles, and by doing so would compensate for the faster revolution of one bevel wheel than the other.

I have described the differential arrangement as it is fitted to small cars which are driven by a live rear axle; but a more usual arrangement for large cars, and one which is adopted by the leading makers, is to have a separate shaft, parallel with the rear axle, called the differential shaft, driven by bevel gearing from the secondary shaft in the gear case. This differential shaft contains the compensating gear just described above, and carries at its extremities two sprockets which drive the rear wheels by means of chains. It will be seen that in this system

of transmission there are no less than four distinct steps—from the engine to the clutch, from the clutch to the gear-box, from the gear-box to the differential shaft, and from the differential shaft to the road wheels; and this is really the mechanical weakness and clumsiness of modern petrol motor-cars. Although exquisite work and fitting are put into it by the best makers, it remains a costly, primitive, and wasteful method of transmitting motion. The extraordinary care and accuracy required in the cutting and hardening of the gears makes it one of the most expensive parts of the motor-car, and the amount of friction

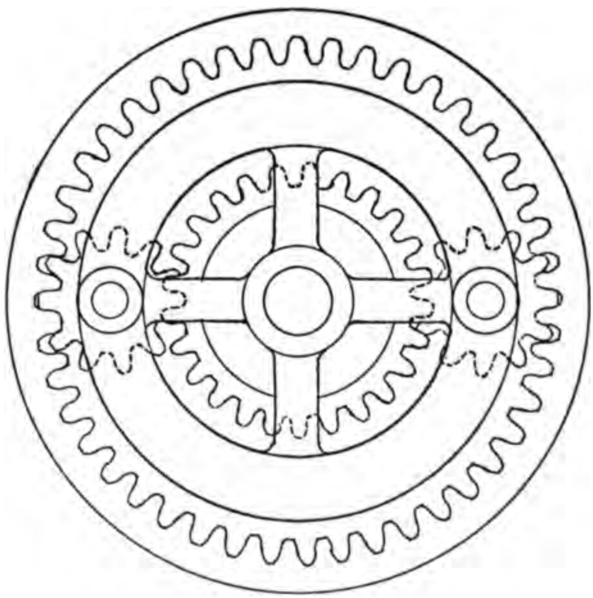


SKETCH ILLUSTRATING TRANSMISSION THROUGH SIDE SPROCKETS AND CHAINS

taken up by the various bearings, chains, and wheels is a serious discount upon the mechanical economy of the machine. In a year or two, I am convinced, we shall see no more of it, and wonder how we could have tolerated so costly and clumsy a method. It is varied by many builders of light cars by what is known as the direct drive and live axle. In this case there is no differential shaft, the differential gear being mounted on the rear axle and driven by a shaft direct from the gear-box. The gearing is so contrived that when the car is on its top speed the secondary shaft is not engaged, and there is consequently no loss of energy between the clutch and the differential gear. This, however, only mitigates, and does not abolish, the evils of

the ordinary chain-speed gear; and it does not wear as well as the chain system of driving.

As in so many other cases, it is to the Lanchester car that we have to look for the most successful attempt on a large car to avoid this somewhat barbarous mechanical device. In this case changes of speed are not achieved by means of toothed wheels which have to be forced into mesh, and which consequently take up their work with considerable jar and wear. The Lanchester system of change speed gear consists of three



SKETCH ILLUSTRATING CRYPTO GEAR

separate trains of Crypto, or epicyclic gear, the principle of which is that by holding or driving different elements of a gear which is always in mesh, different ratios of speed are produced. In two of the Lanchester trains of gearing the central element is formed by the end of a hollow shaft which has teeth cut upon it, these teeth being in gear with the planet wheels of the Crypto. All that is necessary in changing gear is to move the lever which tightens a band on one of the friction drums and locks it, an operation which is perfectly smooth and requires no accurate and noisy shooting of gear wheels into mesh. The

transmission gear of the Lanchester is by a worm gear of splendid efficiency and durability. The rear frame of the car carries within itself the live axles with their bearings and differential gear, which is driven by the special worm and wheel. This worm and wheel is cut at a very high angle, and the form of it has been obtained by very careful calculation, and it is probably due to this accuracy and thoroughness and correctness of principle that the Lanchester worm-driving mechanism is so far ahead of anything else of its class. On the Duryea and Oldsmobile cars a form of epicyclic change-speed gear is also used, and with excellent results; nor have I any doubt that it will rapidly come into far wider use for this particular purpose than it enjoys at present.

A method of transmission which does away with many of the mechanical complications described above is known as the Petrol-Electric System, the principle of which is that the petrol engine, instead of being connected by gears to the road wheels of the car, is made to drive a dynamo, the electricity thus produced being passed through electric motors which drive the road wheels. A good example of this system as applied to touring cars is the Lohner-Porsche petrol-electric car. In this system a Mercédès or Panhard engine and car are used; the engine is coupled to the armature of the dynamo, which is in the position usually occupied by the clutch in a petrol car. The dynamo runs like a fly-wheel inside a circular field magnet, which is attached to the frame, but not rigidly, by means of springs. The driving power is placed in the front wheels, which in this car are the driving wheels. Each of these wheels has a Lohner-Porsche motor enclosed in the hubs, the current being conveyed to them through a controller situated beneath the footboard. A single lever acts on the controller, and the speeds are graduated so that when the lever is pushed back the speed decreases. The motor can be used as a very powerful brake.

Such a system of transmission, a variation of which is used on the Fischer and Hart vehicles, has for its advantages a flexible and complete control in addition to perfectly smooth and quiet running. The absence of gears is also a great advantage; but it must be remembered as a set-off to these virtues that additional complications are involved by the use

of two separate systems of power generation, and that the wear and replacement involved by some parts of the electric apparatus are both troublesome and expensive.

Brakes are an important part of a motor-car; indeed, the motorist has to trust his life to them. There are always two independent brakes on a petrol car, one of which, actuated by a pedal, is generally mounted on the differential shaft, and is of itself powerful enough to control the car under all ordinary circumstances; and the second is applied to drums fixed on the rear wheels, and is actuated by a side lever. These brakes usually take the form of bands encircling a revolving drum, or of expanding drums working within a revolving band. In either case their action is so designed as to act upon either forward or backward motion of the car; and if they are kept in proper order and are properly constructed, the wheels of a motor-car can be locked by them at any speed or on any declivity. In some cars, notably the Mercédès, the brake drums acting on the counter-shaft and second-motion shaft respectively are adapted to be cooled by water, which is automatically allowed to run on to the brake so that the heat generated by the friction of two metal surfaces shall not be excessive.

The steering of motor-cars is almost universally effected on what is known as the Ackermann system. In this the front axle is rigidly attached to the frame of the car. At each extremity is pivoted a short arm, which is free to turn through a small horizontal radius from the end of the fixed axle. On these two arms are mounted the front wheels, on either plain or ball bearings. Other short arms forming part of the two pivoted arms project towards the front of the car, and their ends are connected by a light rod parallel with the fixed axle, so that the turning movement of one wheel is communicated to the other. There are two principal methods by which the driver of the car controls the front wheels: one is by means of a steel tiller connected direct to the steering arm through rods and levers; the other method is to have a small wheel fixed in front of the driver, the turning movement of which is communicated by worm and wheel gearing to one of the pivoted steering arms. The disadvantage of the first system for all but the very lightest cars is that movements of

the front wheels, provoked by inequalities in the road surface, react upon the driver's hand and tend to cause deflection of the steering; while the superior strength and rigidity of the second system, together with the fact that the steering is irreversible and is not influenced by strains thrown on the road wheels, makes its use for ordinary purposes practically universal.

CHAPTER IV

SOME TYPES OF PETROL CAR

Differences in petrol cars—Continental experience and English practice—The Crossley car—A bid for British pre-eminence—The Napier car—The Mercédès car—Lanchesters and Independence—The Daimler car—The De Dietrich car—The Wolseley car—The Renault car—An American example—The Hutton car—Courage and originality—The Thornycroft car.

IT has for long been the ambition of English manufacturers to turn out a motor-car that is as well constructed and of as sound workmanship and excellence of design as the best automobiles built by foreign makers. For a long time the struggle to wrest from foreign competitors the pre-eminence that, although it has been envied, has been frankly recognised, has been strenuously carried on; and there is no doubt that the English manufacturers are rapidly overtaking their foreign competitors and that, although the average of their work is still below the average of, say, the French makers, there are here and there signs that in individual cases an English motor-car can be turned out that can in every respect be favourably compared with a German or French machine of the first class. The difficulties have been very great. The evolution of the motor vehicle up to the present time has been largely assisted by the knowledge and experience gained in connection with racing, and in this matter English makers of motor-cars have lacked the advantages by which their Continental rivals have so greatly profited. In the efforts to obtain lightness combined with strength, moreover, many problems were set before foreign constructors. Aluminium in many alloyed forms had to be used, special steel prepared to stand special strains, and special devices to accomplish special functions.

It cannot be said that the British manufacturers have hitherto

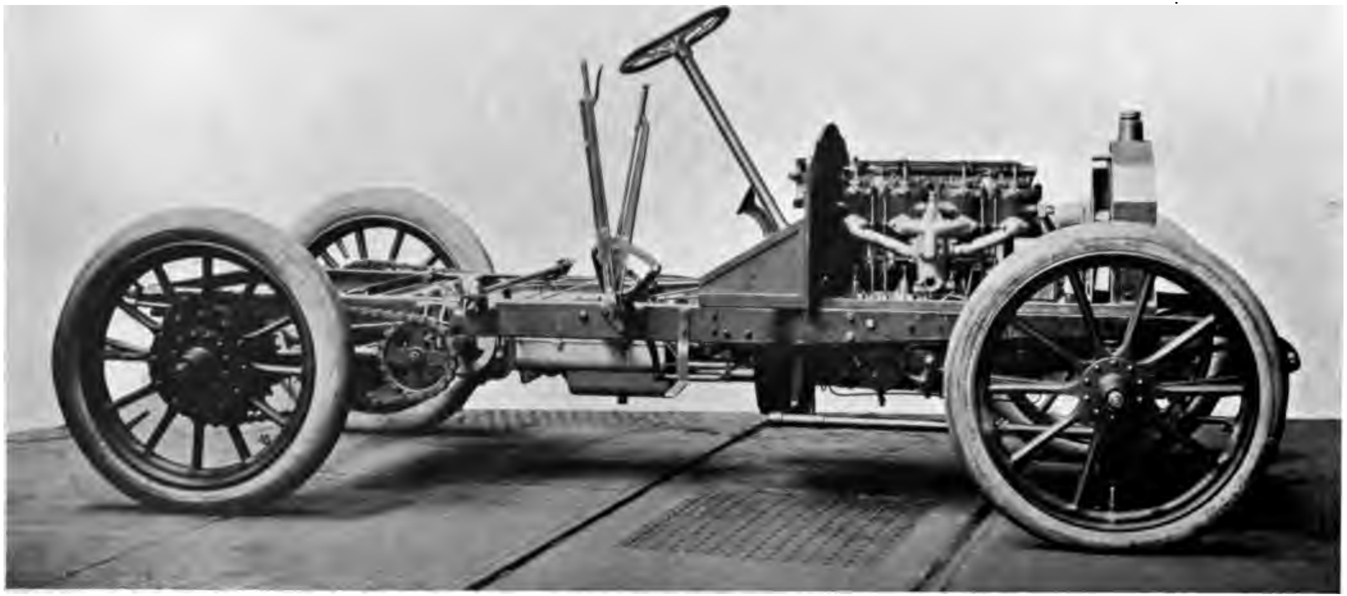
fully availed themselves of Continental experience, for some of the best-known English motor-cars are designed, if not with a contempt for, at any rate with a complete avoidance of, Continental practice; and the result is that although the makers of English cars of repute are few in number as compared with the French and Germans, their practice shows far greater variety and lack of unanimity, even with regard to broad principles of construction. In the descriptions of various cars to which this chapter is devoted I have tried to give as briefly as possible the salient points in connection with a number of cars chosen for the sake of the variety afforded by them. In my list, therefore, will be found more English than foreign cars; but it must be remembered that I have not chosen for description merely what I consider to be the best motor-cars, but have been influenced chiefly by the wish to present a group which among them practically cover the field of modern petrol-motor practice. I have abstained from describing what are sometimes called "freak" cars—that is to say, machines in which eccentricity of construction seems to have been the chief inspiration of the designers. Many of these cars achieve remarkable performances on the racing track, but have no effect upon the development of the industry as a whole, and are of no value whatever to private users. Indeed, I have avoided describing any cars constructed chiefly for racing purposes, interesting as many of them are from the engineer's point of view. The Gobron-Brillié car, for instance, the unique principle of which is that the engine is doubled vertically, and that the explosion in each cylinder drives two pistons in opposite directions, has been carrying everything before it on the Continental short-distance racing tracks; but this system seems too complicated to assist in the development of the motor-car in the direction of simplicity and cheapness.

I have described one car at great length and in full detail in order to give as minute a description as possible to the non-technical reader of the manner in which a modern motor-car is constructed. I have chosen for this purpose the Crossley car, partly because, although it is a new car, it is the work of one of the greatest engineering firms in the world, and partly because it bids fair to place English motor-car construction at last on a level with that of the Continent, and even, perhaps, to wrest

the blue ribbon of popular and expert favour from the famous German Mercédès.

I am, moreover, greatly interested in the attitude of the designers of the Crossley car towards the achievements of other makers. They have shown themselves thoroughly broad-minded, and have evidently been determined, not so much to invent an original machine, as to avail themselves of every fragment of experience that others have acquired; to apply every lesson that has been learned in other schools, and so to produce a machine which is really representative of the very best that the combined intellect and experience, not of one country alone, but of the whole world, can produce. They have not even laid it down as a sacred canon that every single part of the car shall be of their own or even of British manufacture. If anyone else can, in Messrs. Crossley's opinion, manufacture any part of the car better than they can manufacture it, they have not been ashamed to avail themselves of the pre-eminence of other people. This, indeed, raises the whole question as to what constitutes a British motor-car. There are cars which are extensively advertised as being of entirely English manufacture, although, perhaps, if one visits the works where they are built one finds that half the workmen are foreigners. This, I am convinced, need not discredit the excellence of the workmanship; but it is not British workmanship. Moreover, if one goes far enough back in the manufacturing process of such a thing as steel, one may find that there is no such thing as an article produced exclusively by any one country. Therefore it seems to me that the essence of a British-built car is that it should be designed and its principal parts manufactured in England; that the capital devoted to its construction should be English capital, and that the wages spent by the workmen who make it should be paid and spent in England—in other words, that it should be the product of English brains, English methods, and English commerce. Given these conditions, it matters to the British motor-car industry not one jot that certain structural components should be brought from abroad, always provided that they are better than anything that can be made in England. Nationality is no excuse for an inferior article; but national commerce cannot fail to benefit by the spirit of emulation and

THE CROSSLEY 22-H.P. CAR



CROSSLEY 22-H.P. CHASSIS

competition engendered by the use of the best in everything, no matter where it comes from.

I have been tempted into this little economic excursion by the controversies and criticisms that rage round the question as to whether such and such a car is of entirely British manufacture. The views of those who apply the standard of nationality with academic exactness are very short-sighted views, as I think it not unlikely that the Crossley car may prove.

THE CROSSLEY CAR

The Crossley car is the result of a happy combination of three forces working together in the determination to produce a motor vehicle of the highest grade in workmanship and of absolutely first-rate design. As to Messrs. Crossley Brothers themselves, I suppose that no firm in the world has a greater name among engineers, and no firm so world-wide a reputation for the construction of internal combustion engines; and with their experience, their financial resources, and their facilities for manufacture, no firm is in a better position to take up on a large scale the manufacture of high-class motor-cars. The second of the three influences which have combined to produce the Crossley car is Mr. J. S. Critchley, M.I.M.E., for some time works manager of the Daimler Motor Company, and who has been associated with the industry from the beginning. His experience, as one who has followed in minute and technical detail the evolution of the modern motor-car, is no common qualification for the important task of getting out the drawings and attending to the construction of the Crossley car. And then—last, but not least—we have Mr. Charles Jarrott, who, as a member of the firm of Messrs. Jarrott & Letts, has in his hands the selling of the car and the responsibility for the commercial side of the enterprise. The experience of Mr. Jarrott, who has, if I may say so, "grown up" with the industry, who has had unlimited opportunities of observing on the road the forms of construction that have given trouble, noted and analysed the reason for success in other types, appreciated the needs of the public, who is, moreover, in touch with some of the principal Continental works, is invaluable in an enterprise of this kind. Mr. Jarrott has been able to bring to bear on the

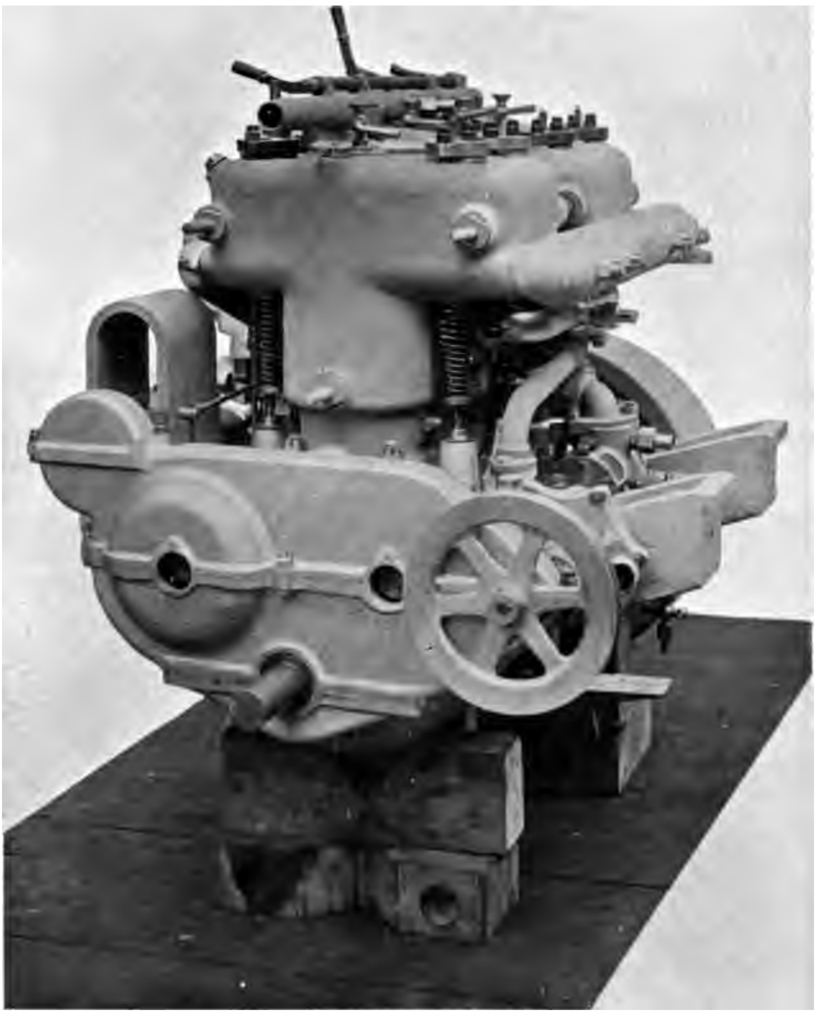
complete car a very critical mind, the expression of which must have been of the highest service to the builders. In dealing with the car in detail I will divide the description under six heads :—

Engine.	Frame.
Carburettor.	Brakes.
Gear.	General Points.

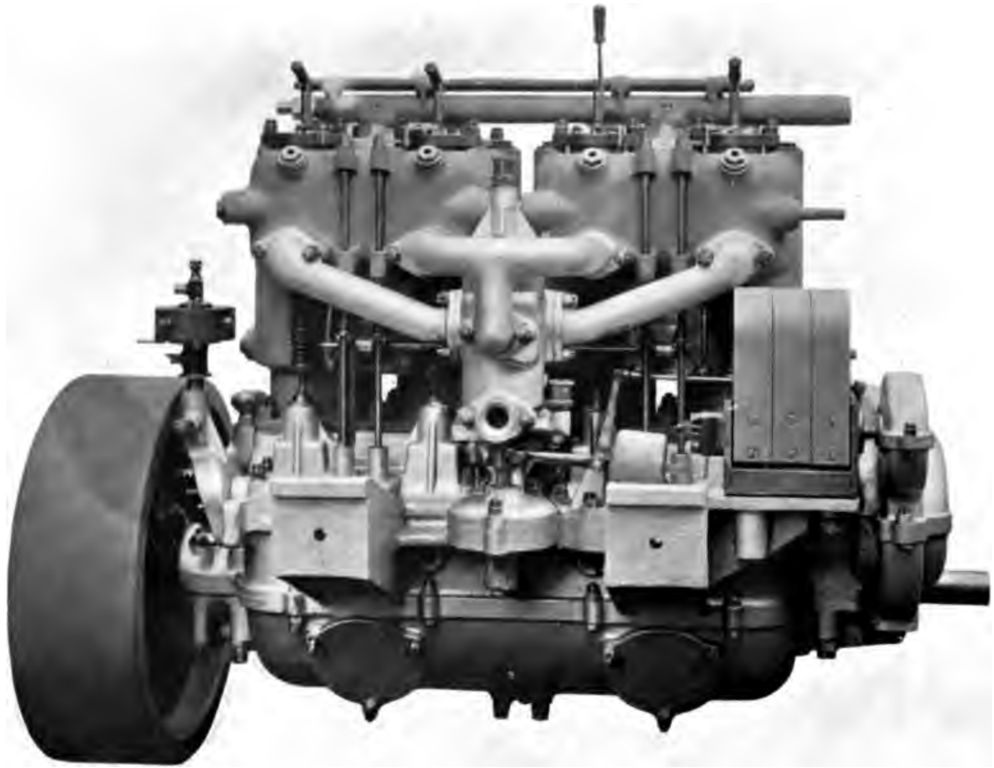
Engine.—The engine is of a very neat appearance, and every part is easily accessible. It is composed of four cylinders, which, in accordance with the best modern practice, are cast in pairs. The horse-power claimed for the engine by the makers is 22 h.p., but actually it develops approximately 28 b.h.p. at a speed of 900 revolutions a minute. The engine is arranged with mechanically operated inlet valves placed on the opposite side and worked by a different cam shaft from the exhaust valves. Magneto ignition of the Simms-Bosch type is fitted, and the ignition plates are arranged in the form of inlet valve covers forming the inspection plates above the inlet valves. Plugs are arranged in the side of the cylinders for the fitting of high-tension ignition should it be so desired, the commutator for this purpose being fitted on the rear end of the engine close to the fly-wheel. Magneto ignition, however, is the standard ignition fitted.

The bore of the cylinders is $4\frac{1}{4}$ inches and the stroke $5\frac{1}{8}$ inches. The cylinders themselves are constructed of cast-iron of a quality specially selected by Messrs. Crossley, the cast-iron being of a harder quality than that generally employed. The pistons are also of the same metal; and in the construction of the piston rings a special machine is used by Messrs. Crossley. The piston rings are not turned eccentric,* but have an equal thickness all round; they are thus turned precisely to fit the cylinder. They are then split and placed in the special machine mentioned, and are automatically hammered to secure the necessary springiness. The hammer has a V-shaped head, and is brought to operate upon the inner face of the ring. Starting at the point where the ring is split, the force of the blow automatically increases as the ring is slowly turned, and the strongest blows are dealt opposite the split and are from this

* See page 44.



CROSSLEY 22-H.P. ENGINE



CROSSLEY 22-H.P. ENGINE. RIGHT-HAND SIDE

t decreased until the whole circuit of the ring has been mered. In this way the metal is rendered springy and :es equal pressure on the cylinder wall at every point.

ıe engine is bored, turned, and faced up in special jigs, so absolute accuracy of every part is ensured; and all the ıinery is true to the thousandth part of an inch. Absolute changeability of cylinder castings on any engine, and of all fittings on each casting, are thus assured. The bearings ıghout the engine are very long and are of a special bronze . The bearings are ring lubricated, and any possibility of ng is done away with.

ıe crank chamber is constructed with ducts which lead the hed oil back again to the bearings. The crank shaft itself ounted on three long bronze alloy bearings. The main ng on the fly-wheel end of the engine is so constructed as event any oil getting out on to the fly-wheel. Liners acting gister rings are introduced between the crank chamber cylinders, and these are so arranged as to prevent an ex- ve quantity of oil being splashed up on to the pistons. crank shaft itself is made of the finest nickel steel, as are :am shafts and the cams, rollers, gudgeon pins, and inlet s; the finest wearing surface possible in connection with very vital parts is thus obtained.

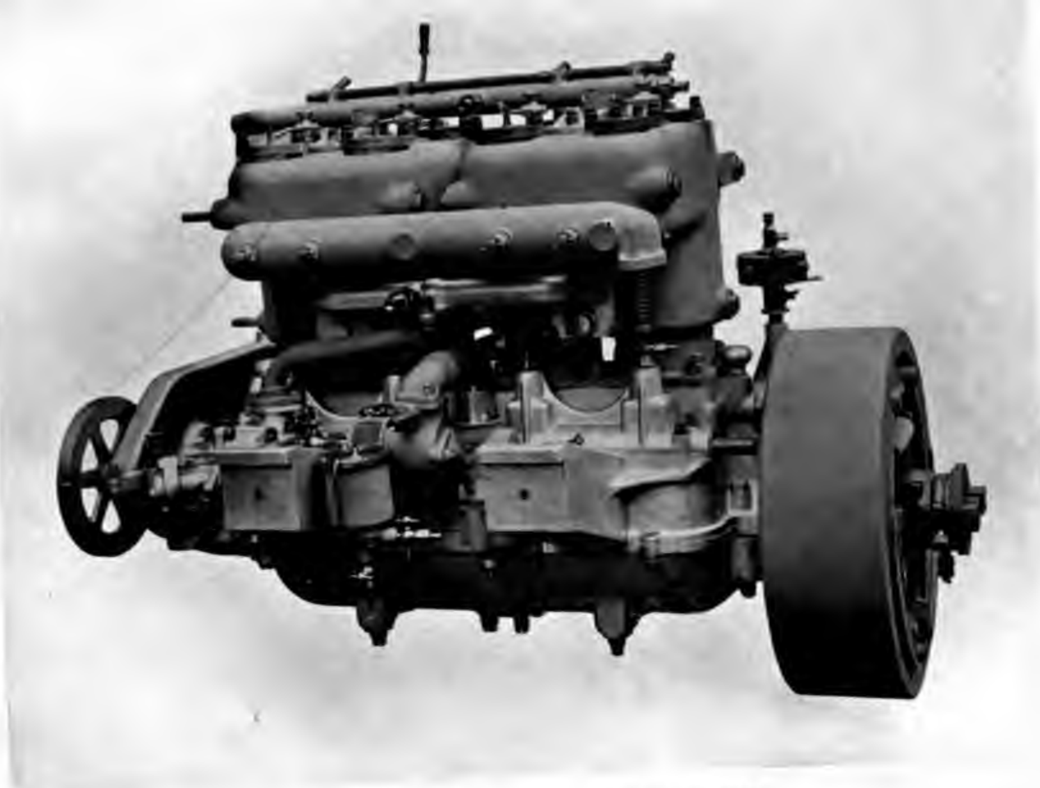
ıe exhaust valves are peculiar, inasmuch as they are com- l, not of steel, but of a very hard special bronze—much er, in fact, than ordinary crucible steel. This bronze will l a very high temperature and always remains clean be- carbon will not adhere to it. This alloy is made by the themselves, and its composition is kept secret.

l the gear wheels which operate the cam shafts are en- d, as are the cams also, and lubricated from the crank ıber. The governor is arranged on the front end of the cam shaft inside the gear wheel. A novel detail in design nnection with the studs and nuts on the engine has been ted throughout, and all studs and nuts have a special d very much stronger than usual and less likely to strip. studs are square between the threads, and the holes in the es which fit on to the studs are also square. It is thus ssible to screw a stud out of the casting when the nut has previously tightened up very hard, and any risk of breaking

a stud in the casting (a common complaint) is practically done away with. Castellated nuts are used throughout, with split pins, so that everything is kept tight no matter what the road vibration may be. The inspection covers above the valves are also fitted with the studs squared between the threads, and the flanged portion of the casings do not actually come into contact with the cylinder casting. They are arranged with valve-shaped seatings beneath, which make a metal-to-metal joint. There is, therefore, no necessity for the use of copper and asbestos washers, which are unmechanical and ineffective.

The magneto is mounted on the upper crank chamber casting, and is driven by a gear wheel in the same casing as the gear wheel which drives the inlet valve shaft. An insulated rod is fixed to the top of the cylinders, and the current is carried from the magneto to this rod, which has four separate switches for making connection with the igniters to each of the cylinders. By this device it is possible to test each cylinder of the engine separately as to its power and regularity. The igniters are operated by disc cams on the cam shaft by vertical rocking levers, and the timing of the ignition is varied by raising or lowering these rods. The magneto itself is geared up very high in order to secure a good spark even at the lowest speed of the engine.

The very important point of water circulation has received special care and attention in the Crossley car. The pump, of the centrifugal type, is very large, and is fixed on to the crank chamber at the left side of the engine, and is gear driven from the exhaust cam shaft. The pump runs very fast, and has a large and effective stuffing-box, which can be easily got out when repacking is necessary. A very full and free flow of water through the engine is secured by the pipes being so arranged that the water enters each pair of cylinders simultaneously, and an even temperature of all four cylinders is maintained. From the cylinders the water is conducted to the top of the radiator, which is of the honeycomb type. For the purposes of cooling the water in the radiator a fan is used. The fan spindle is mounted on ball bearings, and is pivoted in such a way on to the engine that by releasing two nuts the belt on the pulley (the pulley is driven by the exhaust cam shaft)



CROSSLEY 22-H.P. ENGINE. LEFT-HAND SIDE

can be tightened or slackened at will, and need not be taken off—a troublesome detail that causes complaint from the owners of many cars. In all the details of the engine—even down to the fitting of the exhaust pipes—the utmost care can be discerned in design and construction, and even the brass fittings on the motor are evidence of this. As a last feature in connection with the engine itself, the fly-wheel should be mentioned. This is much heavier than usual, which means steadiness of running, and makes it possible also to run the engine at an exceedingly slow speed.

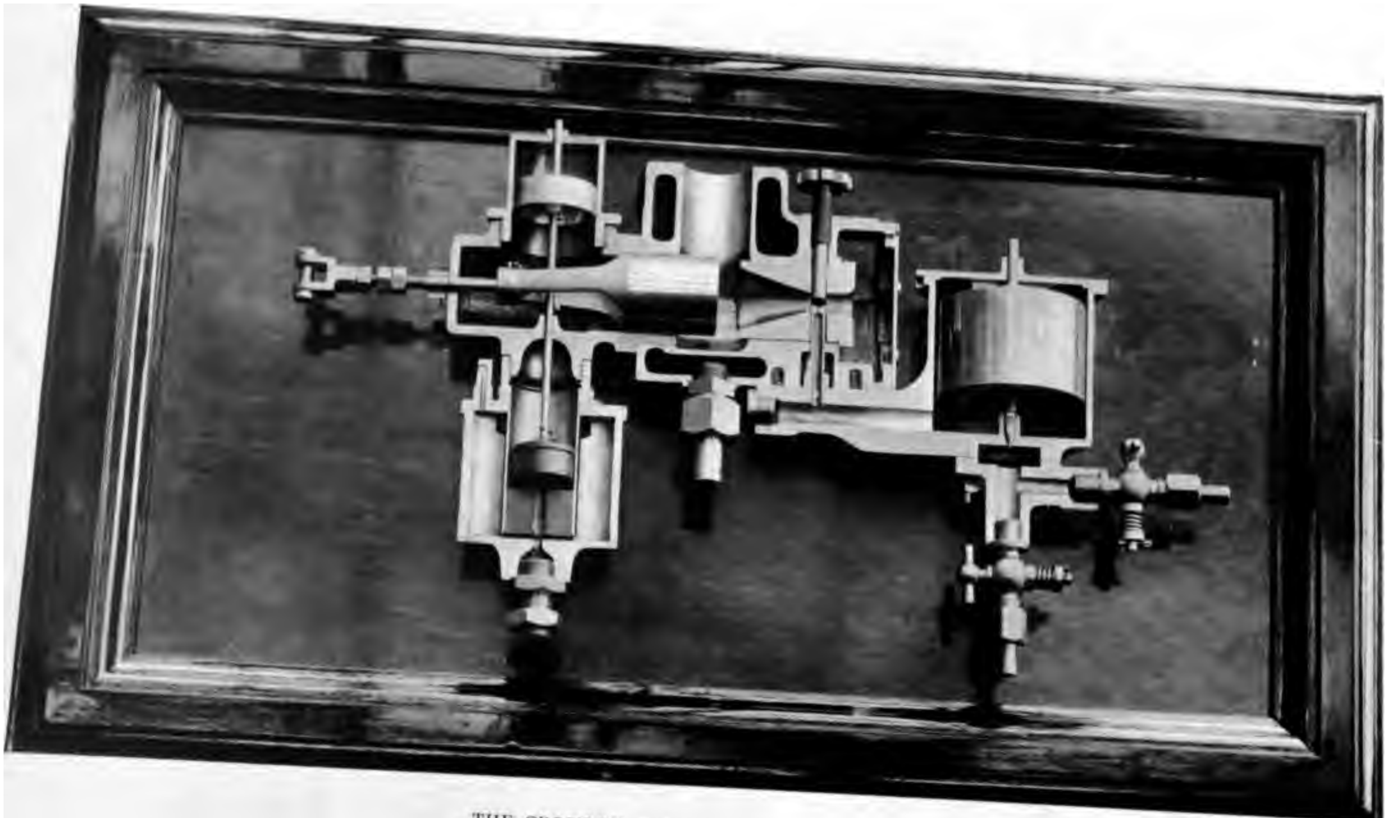
Carburettor.—The carburettor, although part of the engine, deserves a section to itself in view of its exceedingly novel and ingenious construction. Many devices have been tried to secure an automatic action in connection with the gaseous mixture. It was discovered that as the engine speed decreased and the suction of the petrol decreased accordingly, it was necessary to decrease the quantity of air in proportion if one wished to keep the mixture at all constant, otherwise, when the engine was reduced to a very slow speed, the imperfect mixture prevented proper combustion and thus immediately stopped the motor. The Krebs carburettor on the Panhard cars proved in a very convincing manner what an extraordinary difference could be made in the running of the engine when it was possible automatically to govern the quantity of air going into the carburettor according to the speed of the engine. Krebs, however, used a spring, the strength of which was overcome by the suction from the engine when the engine attained a certain speed, and this action opening a port gave an increased quantity of air to the carburettor. Other devices have been tried, Napier using water pressure to do the same thing. The objections to these two methods are, in the first case, that a spring is a variable quantity and is affected by varying temperature; and in the second that the varying water pressure is slow in action, and in the event of derangement of the water circulation the vitality of the engine is seriously affected.

The carburettor on the Crossley car, which, it is claimed, avoids both these defects, is the invention of an American, and Messrs. Crossley have the right of manufacturing it under the English patent. In order to make the explanation clear, I would repeat that the point aimed at is to secure to the engine

an increased volume of air as the engine speed increases, and to reduce the quantity of air as the engine speed decreases.

The construction of the Crossley carburettor is briefly as follows: The ordinary type of float with needle and weighted arms is employed to secure a constant level of petrol. As the petrol enters this vessel the actual float enclosed in the chamber is raised and acts on two pivoted arms, which in turn are forced up and close the needle valve to prevent further petrol entering. As the petrol is sucked out of the jet with which this chamber is connected, it is replenished automatically by the descent of the float allowing more spirit to come in. The petrol supply to this chamber comes direct from the tank, and it can be shut off at two points with special taps which are held into their ground seatings by springs. Before it enters it has to pass through a small chamber in which gauzes are fitted, which prevent any dirt, oil, or foreign matter entering the float chamber and impeding its action. This chamber is fitted with a tap at the bottom to enable the petrol to be run off if necessary. From the float chamber the petrol is conveyed to the jet, which is in direct communication with the induction pipe to the four cylinders. The level of the oil in the jet is governed by the float chamber previously described. As the piston descends to take in a charge of gas a vacuum is formed in the induction pipe, and thus the petrol is sucked out of the jet, and air is drawn through the orifice provided for the purpose, and the mixed gas passes into the cylinder.

So far, except in details of finish, I think there is practically nothing new in the carburettor, and the experience obtained in connection with other types seems to have been freely employed in settling the dimensions. Its novel and effective qualities, however, are found in connection with the auxiliary air supply, the necessity for which has been explained. Attached to the carburettor is an iron chamber, and in this chamber is placed a quantity of mercury, the particular advantage of which is its extreme weight. On the top of the mercury is placed a thin film of glycerine, which prevents the mercury oxidising or "creeping." On the top of the mercury is placed a lignum-vitæ float, to which is attached a spindle that passes through the top of the chamber. In addition, a small hole in the



THE CROSSLEY CARBURETTER IN SECTION

chamber is connected up by a small pipe to another orifice which is situated close to the petrol jet before mentioned.

It will be understood, then, that as the air is sucked up the induction pipe a considerable quantity of air is also taken from the orifice in question, and that a vacuum is thus formed in the chamber described, which holds the mercury and float. It may be mentioned that the float itself and the mercury on which it rests are situated in a separate cylinder inside this chamber, and the suction of air takes place in this separate cylinder. As soon as the vacuum is formed, the weight of the mercury in the outside chamber immediately forces up the mercury in the inside chamber with which it is connected, and fills the vacuum; and as it rises it, of course, raises the glycerine and the lignum-vitæ float resting on it, thus raising up the spindle.

On the other end of the spindle is arranged an ordinary perforated slide. As this slide is raised or lowered more or less air is allowed to come in. It will be understood that the increased speed of the engine creates a stronger suction, and thus the float with the spindle attached is raised higher in the metal chamber and the air port is opened wide. As the engine speed decreases the float is raised less high and less air is admitted through the port; so that no matter what the speed of the engine may be, the regulation of air is absolutely and positively automatic. If the engine is run slowly the suction is small, the spindle is raised but little, and a very small amount of auxiliary air is drawn in. If the engine is run fast the suction is great, the float is raised to its highest point, and the spindle opens the port to its fullest extent, and thus the increased proportion of air for the speed of the engine is automatically given. By this means it is possible to keep the mixture constant even at as low an engine speed as a hundred turns a minute, and at the same time making it possible to run the engine up to 2,000 turns a minute, the variation of air being automatic.

The carburettor has, in addition to the points mentioned, a slide throttle which is operated by hand, and also from the governor. The engine can be set to "govern out," if that is desired; or it can be set to run steadily at a regular speed by the throttle being fixed in a certain position by means of a lever on the steering wheel. The throttle governs the orifice at

the bottom of the induction pipe, and allows a smaller or larger amount of gas to enter the engine according to the position in which it is set. If it is desired that the engine run very slowly and evenly, the throttle is nearly closed. If full power is required, it is pulled wide open, and the full quantity of gas is allowed to enter the cylinders. The whole construction of the carburettor is arranged in a very neat form, and no less than fourteen jigs are employed in its construction. Every part is interchangeable, and it is so made that it can easily be taken down and every piece taken apart and put together again—although the desirability of doing this is to be questioned, especially as there appears to be nothing that will give any trouble or get out of order in its composition. Castellated nuts hold the various parts together. The air orifices are covered with gauze to prevent mud and dust entering, and every little detail where trouble might be expected appears to have been carefully thought out and guarded against. To prevent the mercury splashing about in the outer chamber of the metal compartment above mentioned, steel balls are arranged to float upon its surface, and a small air vent is also provided. This carburettor is partly the reason of the extreme flexibility of the Crossley engine, and also the reason of its great silence; for by its means it is possible to run the engine at such a slow speed as would be impossible with the ordinary type of carburettor.

Gear.—In looking carefully at the change-speed gear on the Crossley car I was conscious of having seen it before; and presently recognised it as being in principle similar to the gear on the Mors cars which performed so well in the Paris-Madrid race of 1903. The important feature in connection with the gear is the fact that a direct drive is arranged on the top speed, thus securing an important elimination of friction. The two gear shafts are placed side by side, and make possible the use of a broad, flat gear-box. This gear-box has a long arm on each side, which is bolted on to the steel frame of the car, and on the rear end of the gear-box (and forming part of the casting) are two brackets, which are also bolted on to a steel cross-stay in the frame—an absolutely rigid suspension. The gear-box itself is of aluminium, is beautifully cast, and seems a splendid piece of work. Four speeds and a reverse are fitted,

the gears being of the sliding type. All the gears, including the reverse, are operated by a single-speed lever placed at the right-hand side of the driver. The top gear, however, is not obtained by putting the two gear-wheels in mesh in the ordinary way. In the first, second, and third speeds, and reverse the secondary shaft drives the bevel gear placed at the rear end of the gear-box, which in turn rotates the counter-shaft. For the obtaining of the fourth speed, however, the secondary shaft is dispensed with, and a jaw-type clutch, fitted to the side of the third-speed gear, but of a much smaller diameter, engages and operates a second bevel arranged by the side of the bevel operated by the secondary shaft. Thus a direct drive on the top gear is obtained straight through from the engine to the cross shaft. Of course, when the top gear is engaged, none of the other gears are in mesh, although they rotate. A special grade of steel is used for the shafts and for the gear wheels, which are ground true after being hardened. Here also all the bearings are ring lubricated, and are specially long; and ball-thrust bearings in cages are fitted to take the end strains imposed by the bevel wheels. Although the gear-box in itself is rigidly fixed to the main frame, the clutch shaft which operates the gear of the counter-shaft (which in turn gives the motion to the road wheels) is arranged with flexible couplings. A special flexible jaw coupling is introduced between the clutch and the front end of the gear-box, and similar couplings are fitted in each half of the differential counter-shaft, so that no matter what the twisting strain may be on the frame, owing to bad roads or any shocks the car may receive, or any straining of the frame, it cannot possibly affect the position of the gear-box. Perfect alignment is thus secured for all the bearings of both the gear-box and the engine, while at the same time it permits the male portion of the clutch always to be dead true. The differential gear is enclosed in the gear-box, and so secures efficient splash lubrication. It is of a heavy and strong type, all wheels being hardened and then ground true.

The clutch is of the expanding type, and is arranged inside the fly-wheel, has a metal-to-metal surface, cast-iron on cast-iron, and is so arranged as to prevent dust and mud from entering it. The shoe pieces of the clutch are expanded by means of an adjustable spring, and arrangement is made by

which any wear can be taken up when required. When it is required to disengage the clutch, the action of the pedal acts against the spring, and the shoes cease to press against the female portion of the clutch. The ends of the counter-shaft are both carried in ball bearings arranged close to the sprocket wheels which drive the road wheels by means of chains. There appears to be a considerable advantage in having the two shafts in the gear-box side by side instead of one above the other, for by this means it is possible, by unscrewing six bolts and taking off the large lid of the gear-box, to inspect any part of the gear should it be so desired, and to examine it in detail. Simplicity has been observed all through in the construction of the gear, while at the same time the effective top drive is secured; and the experience gained in this connection by one of the best-known Continental constructors is taken full advantage of. The four gears on the standard car represent nominal speeds of about ten, twenty, thirty-three, and forty-five miles per hour respectively.

Frame.—The frame is of pressed steel and specially rolled, tapering towards the front in the form of hangers to carry the front springs, and in the rear to carry a curved hanger supporting in its turn one of the ends of the rear spring. The corners of the frame are stiffened internally with angle pieces, and extreme rigidity is secured, owing to the fact that the main supports of the engine itself are bolted on to the frame in front of the car. Two circular solid stays are carried across the frame in the centre for the purpose of holding levers for operating the brakes and clutch, and at the rear end of the gear-box another strong square steel stay is fitted. The length of the frame itself from point to point is 11 feet 11 inches, from the front portion of frame to the radiator, 1 foot 4 inches, from the radiator to the dashboard, 2 feet 10 inches, and from the dashboard to the rear end of the frame, 6 feet 10½ inches, the width being 33½ inches.

The main axles, both front and back, are of H section and exceedingly strong. The road wheels run on plain bearings, as it has been considered by the constructors that in view of the shocks which the road wheels have to stand, ball bearings tend to give trouble without in themselves being an appreciable advantage. The frame is connected to the axles by four springs, very wide and strong. The chief feature to be noticed in the

springs is their great length, which secures an easy swing to the car even on the roughest roads; and there is a complete absence of that road vibration which is so tiring, especially on a long ride. The length of the car and the length of the springs ensure comfortable riding, and no doubt will have much to do with the life and absence of wear and tear on the car. The rear springs are set out from under the frame, so that bumping and jolting through the springs shutting up on bad ground is entirely done away with, and at the same time the necessity for using very stiff springs is avoided. The length of the wheel-base itself, from the axle caps of the back wheels to the axle caps of the front wheels, is 8 feet 5 inches, and the width from centre of tyre to centre of tyre 4 feet 9½ inches. I do not think this question of comfortable suspension of an automobile has received the attention it should have received. Where long journeys are made and big distances covered, comfort and easy riding are an absolute necessity, and it is interesting to note how this point has been appreciated in the design and construction of the Crossley. I think the designers of cars must always ride in front, and never in the tonneau; if they did they would have more mercy on its occupants.

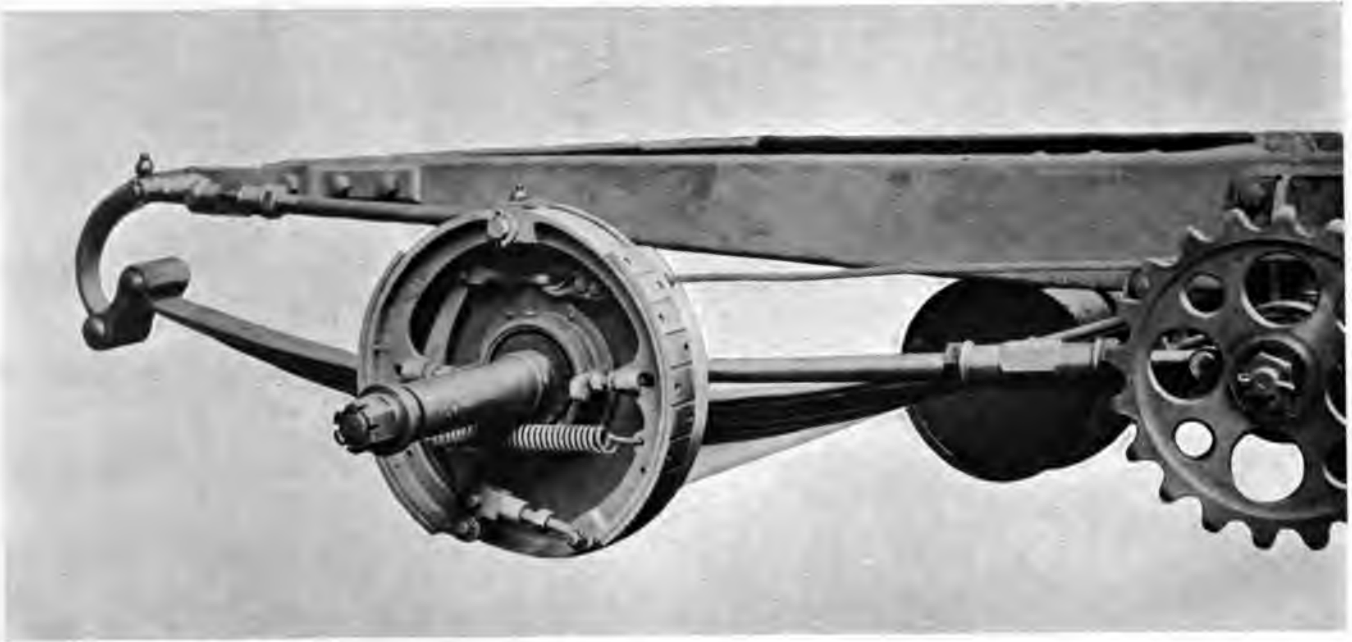
The chains employed to transmit the power from the sprocket wheels to the road wheels are of the well-known Hans Renold make, and of the roller type. In this connection the radius rods fitted between the sprocket bearing and the road wheels are interesting. These are not only of strong and graceful construction, but are fitted with large adjustment nuts of bronze, so that there is no possibility of their rusting and creating another difficulty on the road. The importance of this little point can be appreciated by all those who have endeavoured to slacken out or tighten up an ordinary radius rod on a car when this has not been touched for some time. It is almost always found to be clogged up with paint and rust, so that it is almost impossible to move it.

The road wheels themselves, which are of the artillery type, are built of acacia wood, of the same quality as that used in the wheels of most Continental racing cars. The back wheels have twelve spokes and the front wheels ten. The back wheels are, however, stayed by a steel band of about 12 inches diameter, which is fitted round the hubs and bolted through the spokes.

The sizes of the wheels are 36 inches, having on the front 3½-inch pneumatic tyres and on the back 5-inch tyres.

Brakes.—It is interesting to notice how manufacturers have come to the general adoption of expanding brakes. The Mercédès set the fashion in this direction, and apparently everyone is following in its lead. The advantages are considerable. With the old-fashioned type of brake, in which a band contracts over a drum, one of the difficulties is to attach it in such a way as to prevent it from rattling. Many devices have been adopted, but absolute silence has hardly ever been secured. With the expanding type of brake, which has to be fitted inside the road wheels and attached to the back axle, this difficulty is easily overcome. The action of the brakes is through levers, which force out the shoes that grip on to the inner surface of the brake drum. The whole of the brake is covered in and protected from oil, mud, and dust, and the cover is of such a form as to allow of easy detachment, so that the shoes can be replaced or adjusted whenever necessary. This type of brake is the one which has been adopted on the Crossley car; one is fitted to each of the rear road wheels, and an equal pull on each of the brakes is secured by a flexible steel cord. One of the levers operating the brakes is fitted with a right- and left-hand nut to enable the brakes to be tightened up if necessary. The foot brake is operated by the left-hand pedal in front of the driver, and acts upon the counter-shaft. This brake is also metal to metal.

General points.—The steering on the car is of an exceedingly strong character, and has received special attention. In appearance it looks so unusually stout and solid that it seems impossible for it ever to give the slightest trouble. Ball joints fitted into specially hardened ground sockets are arranged at the point of contact on the levers, and very strong and stiff compression springs effectually prevent any possibility of "backlash." The steering gear is irreversible, and has ball-thrust bearings arranged on either side of the worm gear. The front steering lever rests *on* the ball joints instead of being *held up* by means of them—thus effectually preventing any possibility of this important lever being disconnected. The steering pillar itself is of stout diameter and is hollow, so that a small steel rod and a tube surrounding it can pass down the centre. To



PORTION OF CROSSLEY FRAME

SHOWING BRAKE DRUM FOR REAR WHEEL

this rod and tube two small hand levers are fitted, which are moved over a semicircular rack above the steering wheel. One of these levers fixes the position of the throttle in the carburettor previously referred to, and the other controls the ignition. The rod and tube at their lower ends are attached to levers to control the throttle and timing of the magneto shaft.

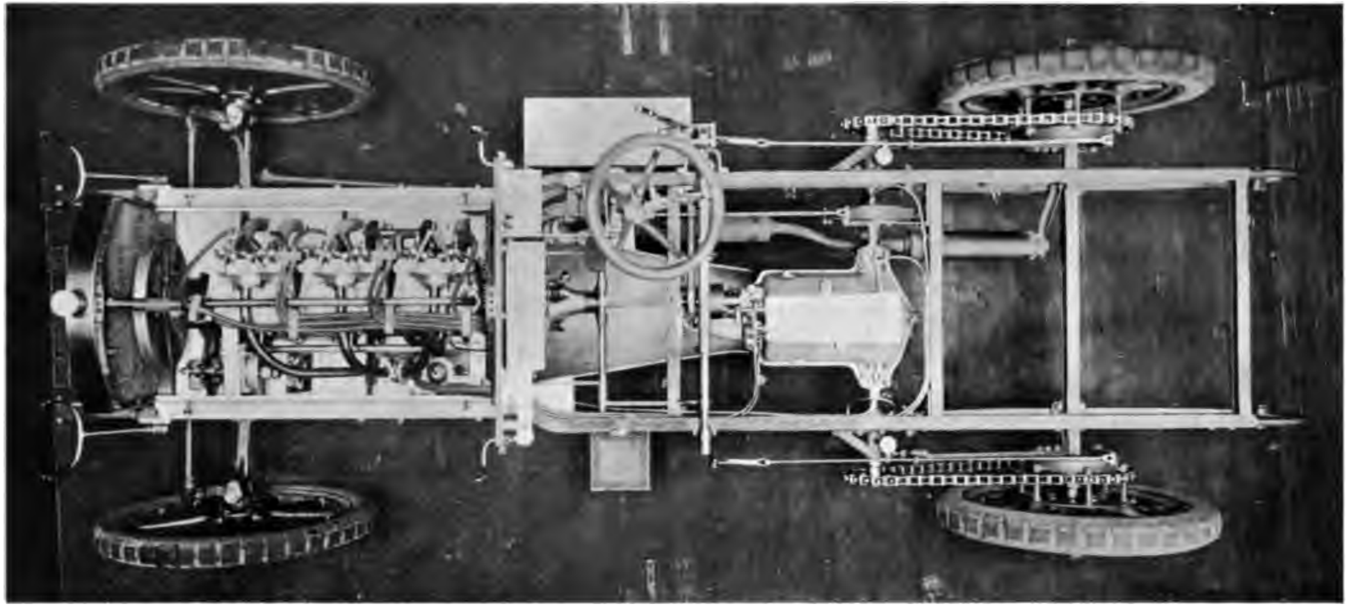
For the purpose of lubrication a neat metal cylinder is attached to the frame on the left-hand side, and this cylinder is connected to one of the exhaust pipes on the engine. The pressure from the exhaust is thus used to forcing the oil up to the sight feed of the lubricators on the dashboard. A separate sight feed is arranged for every bearing, and the lubricating oil is carried along to the four pistons, crank chamber, front bearings of the front gear shafts, and two bearings in the gear-box of the counter-shaft, separate lubricators being arranged for the pump and clutch. Every bearing on the Crossley car, however small, is provided with an oil-cup. This ensures that each of these parts are lubricated, and secures to the car very easy and smooth running, every part working sweetly. In connection with the sight-feed lubricator an important improvement is arranged whereby hot water, which is connected up to the sight feed, circulates from the engine round the lubricating oil, and thus even in the coldest weather ensures the free running of the oil. All motorists are aware how difficult it is on a cold winter's day to keep lubricating oil running freely, and therefore this point on the Crossley is certainly an improvement.

The floor board in front of the driver is sloped up towards the dashboard in an easy position for the feet. Two flat pedals are arranged, one on each side of the steering pillar. By pushing out the left-hand pedal the clutch is withdrawn, and the right-hand pedal operates the band brake on the cross shaft previously described. The steering pillar itself is raked to a position which, from a driving point of view, might be correctly termed "luxurious," that is to say, it is possible to sit well back in a comfortable seat and yet have full control of the car. The two levers on the steering wheel operating the gas and ignition are practically the only things that need to be manipulated to vary the speed of the car. With powerful brakes and a

flexible engine the car can be started and run on the top gear even in the thick of traffic. In sitting on the car, one cannot help noticing the extraordinary flexibility of control of the engine. By opening the control levers the speed can be varied from six to forty miles an hour without changing gear. Indeed, I can hardly speak too highly of the behaviour of the car while running on hilly roads, so far as my personal experience of it goes. Knowing how extreme were the pretensions of the makers and designers, I confess that I looked out very sharply for some fault of behaviour, if only in detail. But I was unable to find any. Carburettor, ignition, valve-gear, and transmission all worked with the inevitable and monotonous precision of a good watch; there was nothing that seemed even likely to give trouble. With four passengers up, the car climbed a hill of 1 in 8 on its third speed; on the level it was possible to run it far faster than the nature of even a good English road made desirable; while in traffic, and throttled down, the engine still ran steady and cool, and, above all, silent.

The lines of the complete chassis, as viewed in the light of up-to-date automobile fashion, are good. The rake of the steering wheel, the strong and solid construction of the brake and speed levers, and the stout lines of the frame and strength of the wheels, all tend to give one the impression of a car strong and powerful, fast but yet controllable, neat and workmanlike—in fact, a real modern road-carriage, complete and compact, with every small detail carefully thought out, with every possible trouble apparently provided for, the convenience of the driver studied, and the comfort of the passengers secured. In the course of time I hope that Messrs. Crossley will be in the position of being able to turn out and manufacture themselves every small detail and part of the car. At present they have been driven to avail themselves of the resources of other manufacturers who have made specialities of certain parts on the chassis. The best has in this way been secured; but when it is possible for the Crossleys themselves, in addition to the engine and other parts of the frame, to make every part, the British automobile industry will almost certainly have a car worthy of its name, and one that will compare favourably in every respect with the finest productions of the Continent.

6-CYLINDER NAPIER CAR



6-CYLINDER NAPIER CHASSIS, FROM ABOVE

THE NAPIER CAR

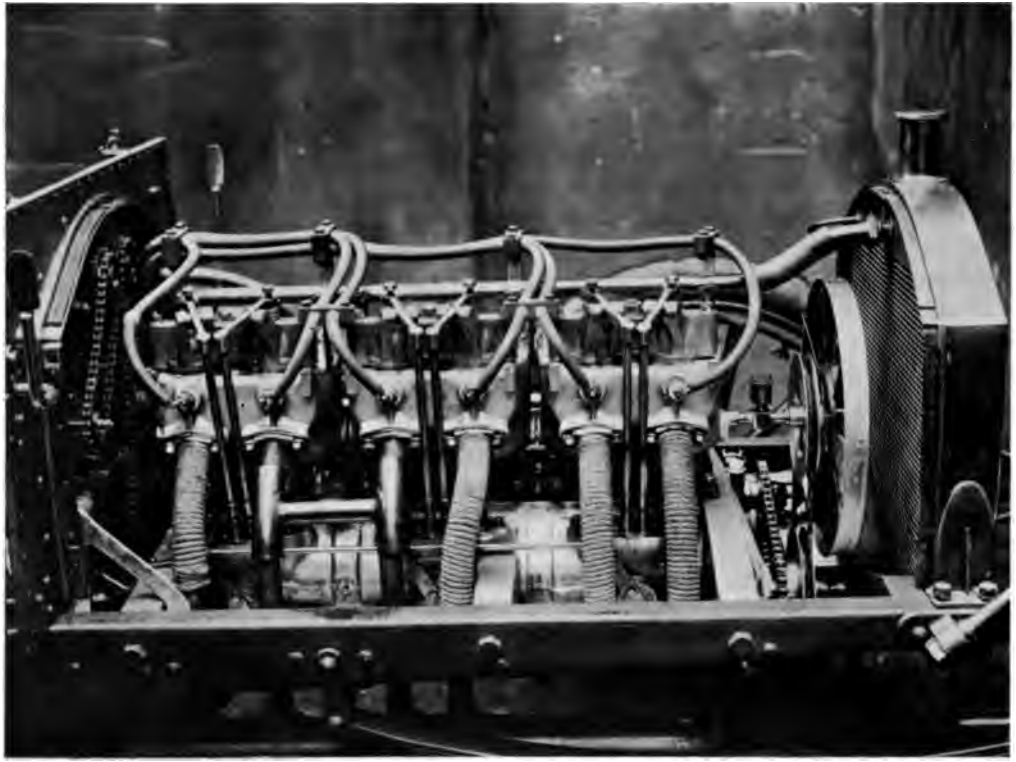
The Napier cars have a conspicuous place in the British motor industry. Although the first Napier car was sold only in 1900, the short time that has elapsed since then has been long enough for these motor-cars to earn a high reputation, not only at home but abroad. This result seems to have been due to two causes—the excellence of the cars themselves, and the brilliant commercial energy with which their sale has been promoted. The whole Napier business, indeed, both in the manufacture of the cars at the splendid Napier Works, and in the selling of them by Messrs. S. F. Edge, Limited, is a lesson in organisation and commercial enterprise to the British motor industry, where businesslike methods and sound organisation seem to be the exception rather than the rule. The winning of the Gordon-Bennett Cup by Mr. S. F. Edge in 1902 was a very fortunate occurrence both for the Napier Company and for the British industry as a whole; and as the Napier cars have now several rivals of their own nationality in the racing world, it will be interesting to see if they retain the advantage secured by their longer experience in the building of racing cars.

The Napier Company build their cars in several standard sizes; but they build neither a small nor a cheap car, the lowest price for a Napier chassis alone being £700, and the highest £3,000. The four-cylinder cars are made in various sizes, 15, 24, 45, and 65 h.p.; and in addition, a six-cylinder car has lately been introduced, in which all the most characteristic qualities of Napier construction are seen quite at their best. The six-cylinder car is made in two sizes, 30 h.p. and 90 h.p., the last being, of course, a racing car. The 30 h.p. six-cylinder car, which is the one I have selected for illustration and description, has been designed with a view to producing the greatest possible degree of luxury and simplicity of control that is possible in a petrol motor-car. That is to say, the complication is all in the manufacture, and the driving of the car is simplicity itself. I have already mentioned some of the advantages of a multiple-cylinder engine, and shown how, up to a certain point, an increase in number of cylinders gives an increase in smoothness of running and flexibility of control. The disadvantages are found in the increased complication and expense, all the

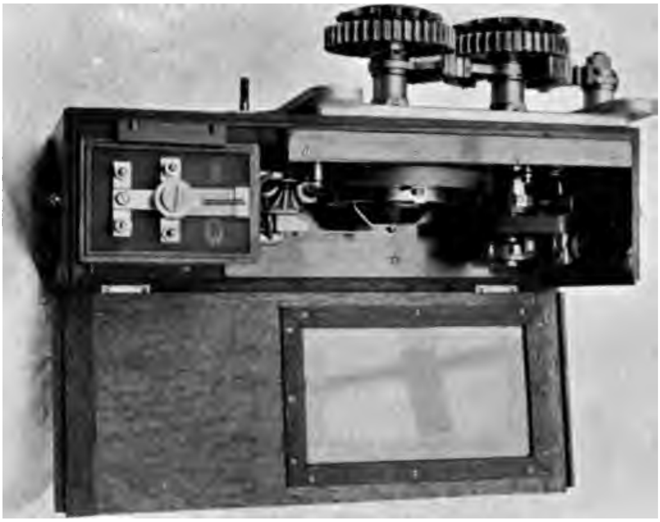
working gear of the engine being reproduced six times as against once in the single-cylinder motor. In a carriage of 30 h.p., costing £1,200, it may, however, be assumed that all considerations of price have been ignored, and that the makers have aimed at producing, for the limited number of people who are able to pay for it, the best and most luxurious that is possible in motor-car construction, regardless of expense. The result in this case is a petrol motor-car which has much of the flexibility of the steam engine, and in which the necessity for changing gear is practically done away with, as on the direct drive the car can be driven at speeds varying from four to fifty miles an hour by the use of the throttle alone.

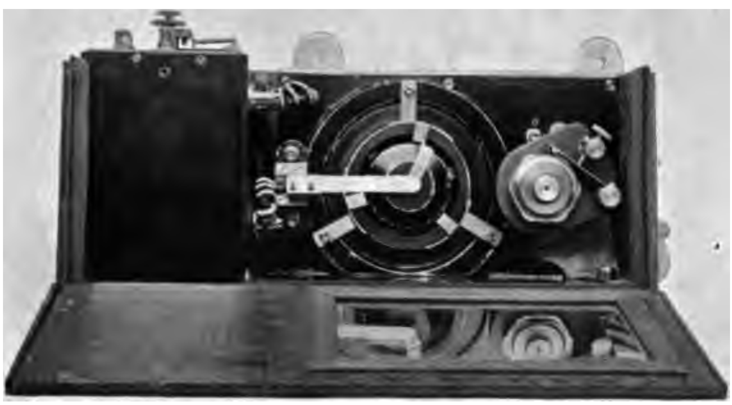
The general lines upon which this car is constructed will be seen in the illustrations. The frame, which is of rolled steel, is very much narrowed in front where it carries the engine, and this allows to the steering wheels a very full lock. The six-cylinder vertical engine has its cylinders cast in pairs; all the valves are mechanically operated, the inlet valves being placed exactly above the exhaust valves. These inlet valves are constructed according to a patent of Messrs. Napier and Edge, an annular multiple seating being devised which gives to any diameter of valve a much larger circumferential opening than is possible with the ordinary single-port valve. The engine, which is entirely enclosed, transmits its power through a metal-to-metal clutch which is very sensitive and powerful, and although capable of transmitting 40 h.p., can be thrown out of action by the pressure of a weight of 2 lbs. A short universally-jointed shaft leads from the clutch to the gear-box, which is comparatively small and light, and is very neatly arranged. There is a direct drive on the top speed, and when this is in action none of the intermediate gear wheels are revolving, but lie idle. As the car is designed to be driven practically continuously on the top speed, this disposition of the speed-gear effects a great saving of wear. The gear drive is to a differential shaft, from which the rear wheels are driven by means of side sprockets and chains. Internal expanding brakes are provided on the rear hubs, and a metal-to-metal brake on the counter-shaft, the latter being actuated by a pedal and cooled by water admitted through a tap on the dashboard.

It is in the six-cylinder engine itself, however, that the chief



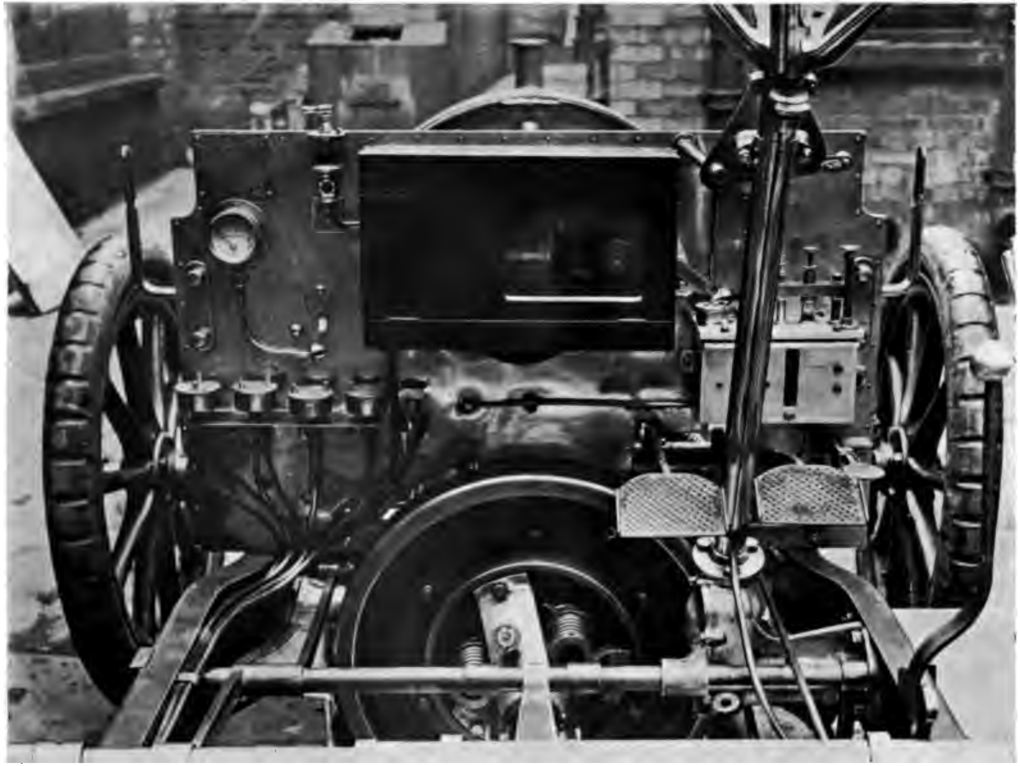
6-CYLINDER NAPIER ENGINE. RIGHT-HAND SIDE





THE NAPIER SYNCHRONISED IGNITION DEVICE

6-CYLINDER NAPIER CHASSIS. FRONT VIEW



CLUTCH, PEDALS AND DASHBOARD OF 6-CYLINDER NAPIER CAR

interest of this handsome car lies. Many makers have attempted to build six-cylinder engines, but the results have nearly always been unsatisfactory because of the difficulty of timing the electric spark for the explosions accurately. One reason for the great smoothness and beautiful balance of the six-cylinder engine is that the explosions in successive cylinders, as it were, overlap one another, and that the cycle of operations begins again in number one before it is completed in number six, so that an even and constant ripple of explosions is being sent down the line of cylinders. This, however, is only effective so long as the timing of the electric sparks is absolutely perfect, and I think I am right in saying that it was never possible until Messrs. Napier introduced their synchronised ignition. The principle of this ignition is, first, that only one coil is used for any number of cylinders. A box containing the whole of the mechanism is mounted on the dashboard and fitted with a glass panel, through which the driver can see the whole of the working of the mechanism. The commutator is in the Napier system of ignition really unnecessary, although it is retained on account of the economy it effects by preventing the coil from trembling continuously. The action of the high-tension distributor as it travels round is to divert the whole of the electric current momentarily to the particular plug that requires it; and so in turn, and in an order accurately governed by the running of the engines themselves, to feed any number of firing plugs that may be used. Each cylinder fires thus at an absolutely correct moment in relation to the one before it and the one after it, and the loss of power that results from irregular firing and from one cylinder lagging behind the other is avoided. This ingenious ignition arrangement is driven by gears from the engine itself.

The cooling of the Napier engine is effected through a honeycomb radiator consisting of very thin tubes, which are rendered strong enough for their purpose by a system of fluting each tube in four places. By this means large water spaces between the tubes are created, and the greatest possible amount of metal is exposed to contact with the air and with the water. An aluminium fan mounted behind the radiator is driven by a belt. A ball-bearing pump provides for the circulation of the water, and this is fitted with an ingenious cut-out arrangement, so that if any foreign body should get into the pump and stop it the

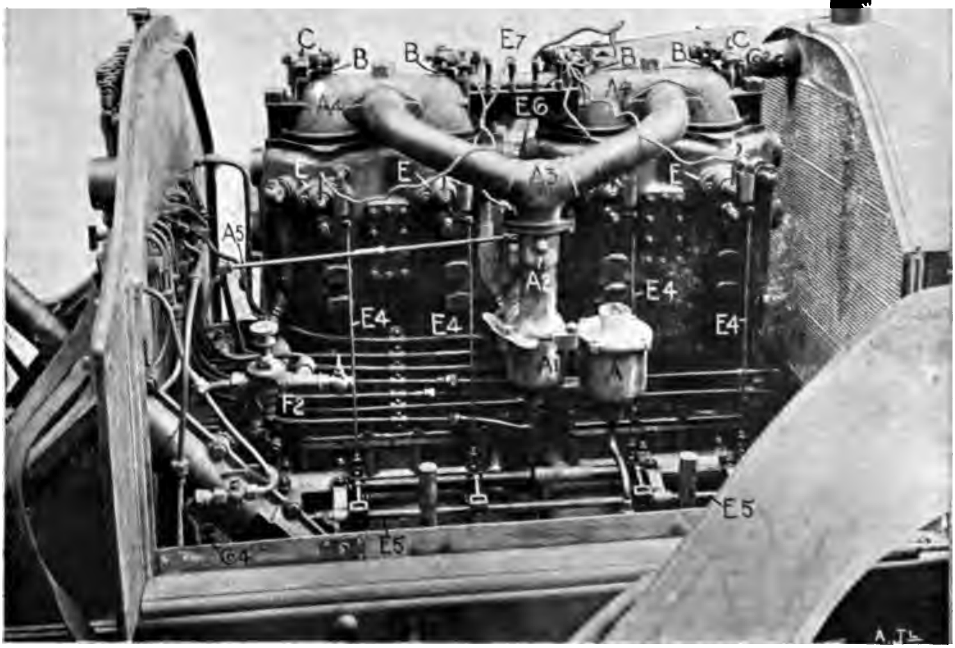
whole pump is not wrecked, but is protected by two small breakable prongs, which are easily renewed. Lubrication throughout the car is positive and automatic, oil being pumped to all parts of the engine and car, and special grease-cups being fitted on the dashboard for the lubrication of the gear-box.

One of the many excellent features of the Napier cars is the carburettor, of the float-feed spray type, which is now fitted with a hydraulic auxiliary air regulator for the purpose of diluting the mixture formed in the mixing chamber. This device consists of a valve controlled by a diaphragm attached to the pipe through which the auxiliary supply of warm air passes to the carburettor. The passage through this pipe is partly obstructed by a valve which, when it is pressed inward by the diaphragm, enlarges the opening through which air can pass, but is normally held out by a spring in such a position that the passage of air through the pipe is almost completely throttled. A pipe from the circulating water system is led into the hollow casting behind the diaphragm. Now the pressure of the water in the cooling system depends upon the speed at which the engine is running; as the engine slows the pressure is reduced, and as the speed increases it rises. As the speed of the engine increases, therefore, the water in the casting presses increasingly on the diaphragm, which opens the valve and admits more air to the cylinders. The variation is thus entirely automatic and, theoretically at any rate, in exact accordance with the requirements of the engine.

THE MERCÉDÈS CAR

The unique position attained by the Mercédès car may on the whole be attributed to perfection of workmanship and the determination on the part of the designers and builders to include nothing but what was first-rate, even though the price of the car should thereby be raised to a figure which should place it beyond the reach of the ordinary motorist. This policy was more than justified in the results; for the Mercédès car rapidly took its place at the head of the list even of first-rate cars, and the winning of the Gordon-Bennett Race in 1903 by a Mercédès car gave to its makers the blue ribbon of the automobile world. When the car was brought out a few years ago,

60-H.P MERCEDES CAR



60-H.P. MERCEDES ENGINE. RIGHT-HAND SIDE

A—FLOAT-FEED CHAMBER
A_1—SPRAY CHAMBER
A_2—THROTTLE VALVE
A_4—CYLINDER-HEAD CASTINGS
A_3—BRANCH FEED PIPE
A_5—ROD FROM GOVERNOR REGULATING THROTTLE
B—VALVE SPINDLES
B_1—HORIZONTAL ROCKING LEVERS OPERATING INLET VALVES
B_2—PARAFFIN COCKS
E—LOW TENSION IGNITERS
E_4—RODS ACTUATING ROCKER FOR BREAKING CONTACT
E_5—LAY SHAFT FROM WHICH TIME OF IGNITION IS VARIED
E_6—CONTACT BLOCK IN WHICH WIRES ARE COUPLED
E_7—TAPERED PLUGS FITTED INTO DITTO
F_2—PRESSURE FEED VALVE FOR LUBRICATORS
G_2—WATER PIPE BETWEEN RADIATOR AND CYLINDER JACKETS
G_4—GEAR WHEEL OPERATING CAM SHAFT

moreover, the design included a great number of features which were quite novel and original, such as the honeycomb radiator, the Mercédès clutch and valve gear, internal expanding brakes, and the safety device applied to the change-speed lever; and although the Mercédès car still maintains its lead, other makers of motor-cars have not been slow to take advantage of the ingenuity and excellence of the Mercédès design, so that many of its best features are no longer peculiar to it, but have been adopted on most of the leading motor-cars. It is therefore not now so remarkable and unique a machine as it was when it came out, although it is probably true to say that in matters of design and construction it still sets the fashion for the majority in motor-car design.

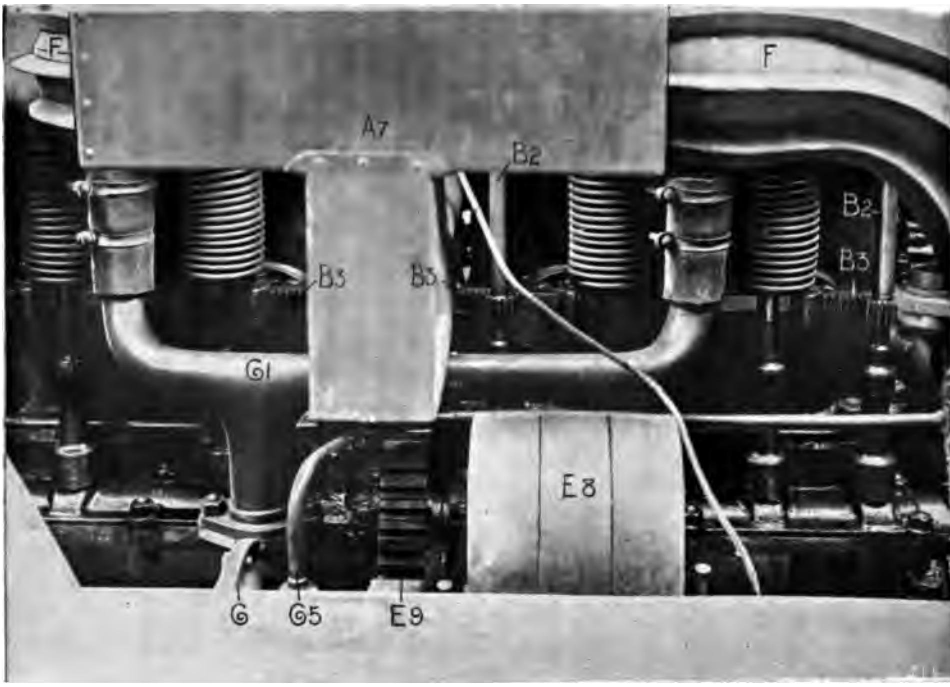
The structural arrangements of the Mercédès car are those which have been accepted as the best among the majority of motor-car manufacturers. The frame is of stamped steel, the side members of which are continued forward in front and curved over into arms for carrying the front ends of the springs. The engine and gear-box are fixed directly to the main frame, and are covered in from dust below as well as above. The Mercédès springs, which support the frame, are remarkably long and have but little curve, the method of suspension employed, however, securing for the carriage a very easy and pleasant freedom from road vibration. The drive to the rear wheels is by means of chains working on sprockets fixed at the ends of the differential shaft, the movement of which is thus communicated to the road wheels.

The engine has four cylinders, which are cast, with their water-jackets, in pairs. The inlet valves are situated centrally above each cylinder,* and the exhaust valves in separate chambers on the left-hand side of the engine. The inlet valves are operated by horizontal rocking levers, the movement of which is supplied by vertical rods actuated by cams on the half-time shaft. The method of controlling the Mercédès car, which is perhaps one of the most successful adopted on any petrol car of standard design, allows for a great variation in the amount of gas admitted to the cylinders. This is achieved by a mechanism which alters the lift of the inlet valves, and is con-

* This does not apply to the latest pattern of Mercédès engines, in which the inlet valves are situated on the right-hand side of the cylinders.

trolled by a lever fixed on the steering wheel. The vertical rods (B2), which communicate the movement of the cams to the rocking lever actuating the inlet valves, are screwed at their upper ends into the joint fitting by which they are connected with these rocking levers (B1). The rods themselves can be turned about their own axes, and so be made to screw into or out of the sockets at their upper ends, the length of the connection being thus varied. At their lower ends small pinions, which are clearly shown in the illustration, are mounted on them. These pinions engage in a toothed rack (B3), which lies parallel with the cylinders between them and the vertical rods. It is the movement of this rack-bar, communicated from the handle on the steering wheel, which varies the lift of the inlet valve, and so varies the quantity of explosive mixture drawn into the cylinders. The period of the stroke at which the valves are opened is also varied; when the rods are given their greatest length the valves are opened at the beginning of the suction stroke and closed at the extreme end of the stroke; as the rods are shortened the valves are opened later in the stroke and closed earlier, so that in that position they are not only opened for a shorter period in each stroke, but the extent of the opening is less. This very delicate variation permits the engine to be run with the very smallest amount of gas when the load is light—a circumstance which has much to do with the smoothness and quietness of its running. It also renders it extremely elastic, making frequent changes of gear unnecessary. In spite of its advantages, however, this device has not been retained on the very latest patterns of the engine.

The ignition of the Mercédès engine is of the low-tension magneto type, the igniters being placed on the right-hand side of the cylinders, and they are operated by a separate cam shaft, the time of the ignition being varied by a mechanism which causes the cams operating the igniters to come into contact earlier or later in the stroke as may be desired. The wires leading to the four ignition plugs are led into a contact-block by small plugs, any one of which is quickly detachable. A single insulated wire leads the contact-block from the magneto; any igniter can thus be rapidly disconnected and a fault easily discovered. The magneto (E 8) is fixed on the left side of the crank chamber, and is driven by a spur wheel (E 9), which is



60-H.P. MERCEDES ENGINE. PART OF LEFT-HAND SIDE

A7—METAL CASING ROUND EXHAUST PIPE
B2—VERTICAL RODS TRANSMITTING MOVEMENT OF CAMS TO THE VALVES
B3—PINIONS WORKING TIMING GEAR OF INLET VALVES
E8—MAGNETS
E9—SPUR WHEEL DRIVING MAGNETS
F—FITTING FROM WHICH EXHAUST PIPES ARE LED
G—CIRCULATING PUMP
G1—BRANCHED PIPE FROM RADIATOR TO WATER JACKET
G5—OIL PIPE FOR LUBRICATING CIRCULATING PUMP

60-H.P. MERCEDES CAR. VIEW OF CLUTCH, DASHBOARD AND OPERATING LEVERS AND PEDALS

F_3 AIR PUMP FOR PRESSURE ON TANKS
F_4 SHUT-OFF VALVE OF DO.
F_5 LEVER CUTTING OUT SILENCER
F_6 PRESSURE GUAGE
G_6 GREASE CUP FOR CIRCULATING PUMP
H FLYWHEEL
H_1 CASING ATTACHED TO DO.
H_2 LEVER TIGHTENING CLUTCH COIL
J_1 HELICAL CLUTCH-SPRING
J_2 CLUTCH PEDAL
K_1 CHANGE SPEED LEVER
L BRAKE BAND ON DRUM ON SECOND-MOTION SHAFT
L_1 LEVER OPERATING DO.
L_2 PEDAL ACTUATING FOOT-BRAKE
M – LEVER OPERATING BREAK ON DIFFERENTIAL SHAFT
N HAND LEVER FOR SIDE BRAKES
P MULTIPLE SIGHT-FEED LUBRICATOR
P_1 LUBRICATOR FOR CRANK CHAMBER
P_2 TAP CUTTING OFF OIL SUPPLY FROM LUBRICATOR

mounted on the middle of the inlet cam shaft. The exhaust valves, which have flat instead of conical seats, are actuated from the same cam shaft, the whole of the cams on this shaft being enclosed in a casing that forms part of the crank chamber. The Mercédès inlet valves are triple-seated, there being two separate annular and concentric spaces through which the explosive mixture passes. The valve-head is provided with a slot for the insertion of a tool for grinding purposes, all three seats being, of course, simultaneously ground. The advantage of these triple-seated valves is that the area of opening is greater than if an ordinary single-seated valve were used.

The cooling is by means of a honeycomb water-tank, through the opening of which air is drawn. The spokes of the fly-wheel are cast in the form of a fan, and the bonnet covering the engine containing no openings, this fan fly-wheel draws a continuous current of air through the radiator. Circulation is maintained by a centrifugal pump, which draws the water from the bottom of the radiator and delivers it at the bottom of the water-jackets, from the top of which it returns to the top of the radiator. All the moving parts are lubricated from a pressure lubricator fixed on the dashboard, the pressure being derived from the exhaust gases, which also distribute pressure to the petrol tank and to the water used for cooling the brake drums. The exhaust gases are led to a single exhaust pipe, which passes to the rear of the car and terminates in a large silencer. This connection can be cut out and the exhaust gases allowed to escape directly to the atmosphere by means of a fitting on the dashboard; thus greater power can be momentarily attained if desired, and the working of the four cylinders verified by the sound of the exhaust.

The motion of the engine is transmitted through a clutch of the coil type in which the coil is in the form of a helical spring, one end of which is fixed, and the other is connected with a lever, so that the coil can be tightened up and caused to grip a drum inside the clutch. The clutch is connected with the first-motion shaft, on which are sliding spur wheels giving the different ratios of gear. Corresponding spur wheels are rigidly fixed to the second-motion shaft, which lies to the left of the first-motion shaft and parallel with it. Its forward end carries a brake drum, which is actuated by a pedal; its rearward end is

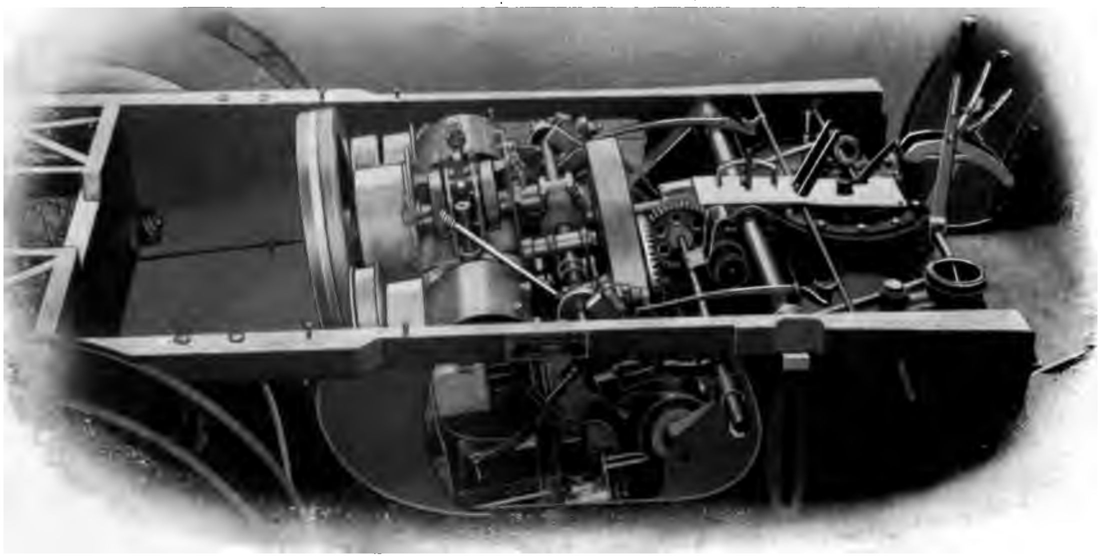
in the bevel wheel which drives the differential gear. On the differential shaft there is (in the larger cars) another metal-to-metal expanding drum brake which is also water-cooled and actuated by a pedal. All the shafts run in ball bearings, and there are ball-thrust bearings from the ends of the counter-shaft. All the speeds are controlled by a single lever, which is moved sideways into one or other of three parallel slots in the quadrant, a positive backward or forward movement in each of these slots giving the four speeds, reverse, and neutral positions. The steering gear is of the screw pattern, a block travelling up and down the steering post when the wheel is turned, and this motion is transmitted to the steering heads by means of a crank lever with which it engages. All four wheels on a Mercédès car are fitted with ball bearings. A spray carburettor of very simple type is used, and it is fitted with a throttle valve, which is acted upon by the centrifugal governor. A fitting is provided whereby the proportion of air drawn into the mixing chamber can be regulated at the carburettor itself.

The perfection of the Mercédès engine is shown in its smooth and sure running, the perfect regularity with which it receives the combustible mixture in exactly the right quantity and proportion, and the clock-like steadiness with which the cylinders fire. If the silencer is cut out and the individual explosions of the exhaust are listened to, the sound is more like that of a very evenly worked maxim gun than like the somewhat spasmodic throbs given out by less excellently designed and constructed machines. The Mercédès cars are made in various sizes and powers, the lowest being the 18–28 h.p. car. Other sizes are of 24–28 h.p., 28–32 h.p., 35–40 h.p., 40–45 h.p., 60 h.p., and 90 h.p., the last being made only for racing purposes.

THE LANCHESTER CAR

There is probably no more interesting motor-car from the engineers' point of view than the Lanchester. It is the outcome of an extraordinary care and originality in design, and an extraordinary amount of deliberation and preparation. It is typical of the care with which this car has been designed that although it made its first appearance at the Richmond Trials in 1899, when it secured the gold medal, it was neverthe-

LANCHESTER TOURING CAR, WITH SPECIAL LIGHT BODYWORK AND STREAM-LINE MUDGUARDS

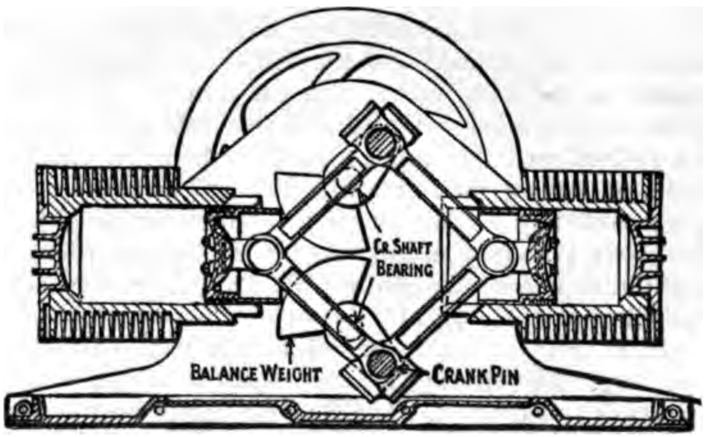


LANCHESTER ENGINE AND GEAR

less withdrawn again and entirely re-designed, and was not offered to the public until 1901. Since that year the success of this car with English users has been remarkable; and it says much for the care and genius of its designers that in principle the original model has never needed to be changed. Slight details have here and there been improved, and in deference to the widespread public taste in regard to engine cooling, the water system instead of the air system was introduced in 1904. Beyond these changes, however, the car remains practically as it was when it was first offered to the public; and as it is entirely unlike any other motor-car at present built, it merits a somewhat detailed description.

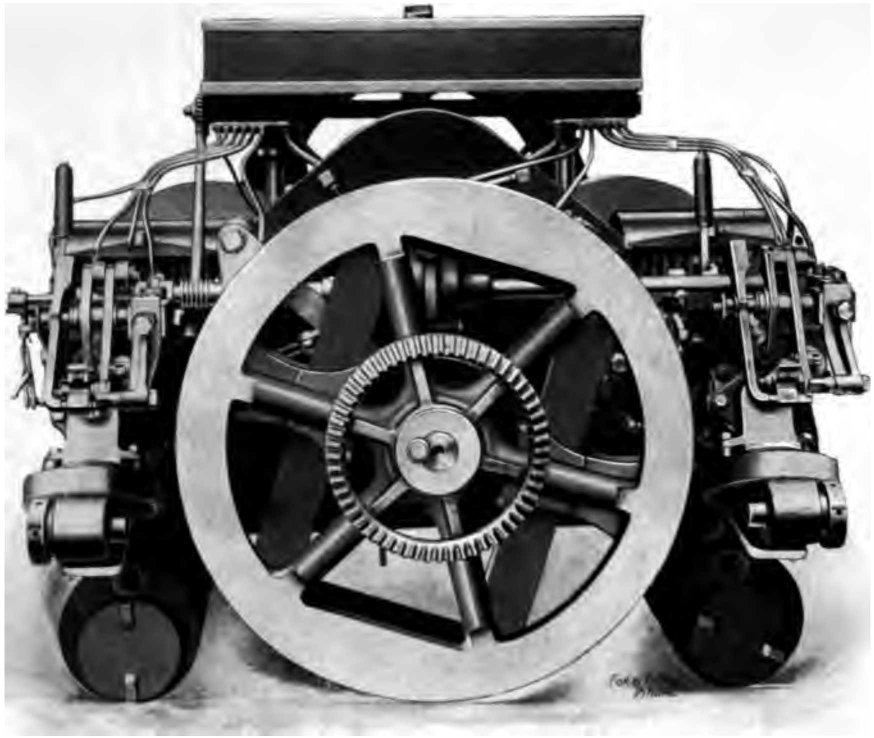
The engine in a Lanchester car is placed, not in front or behind, but in the middle of the frame, and it is quite independent of the body work. The car frame consists of two girders of aluminium plate and mild steel, which are connected by a 12-inch steel tube which also forms the petrol tank. The system of staying the frame with ties and bulkheads ensures an extraordinary rigidity in proportion to the weight. The Lanchester is indeed remarkable for the way in which both weight and undue strength are avoided where they are not required, and the way also in which unusual strength and weight if necessary are secured in the vital parts of the machinery. The steering mechanism, for example, is remarkably heavy and massive. The steering wheels are mounted in the usual way on independent axles, which are connected to the front frame by very solid ball heads; and the transmission from the car frame, where the steering lever is fixed, to the under frame is by means of a direct link which is in approximate alignment to the parallel motion by which the front frame is attached. The car is steered by a tiller fixed on the right-hand side of the car, this being entirely different either from the wheel system of steering or the American side-tiller system. In the Lanchester the tiller is moved in the direction in which the car is desired to go, and this in practice makes over-steering almost impossible, owing to the centrifugal force which acts on the driver's body, and tends to counteract his steering effort. The car frame is designed with a level top, so that when the carriage body, which is easily detached, is lifted up, the whole of the mechanism is exposed and accessible.

It will be seen at once from the illustration that the engine differs radically from any other petrol engine at present in use for motor-cars. It is what is known as a balanced engine, and is claimed to be the only reciprocating motor-engine which is perfectly balanced in every respect. The system of balancing will be seen from the illustration. The two pistons and connecting-rod link-work have their common centre of gravity always half-way between the two crank pins—that is to say, that the two crank pins revolve in opposite directions; the centre of gravity of the moving parts moves to and from along the axial line of the cylinders. It is the movement of the mass



SKETCH SHOWING BALANCE OF LANCHESTER ENGINE

of the reciprocating parts, as indicated by the motion of their common centre of gravity, that is the cause of the vibration of most reciprocating engines, and it is usual to neutralise this effect by opposing rotating balance weights which tend to neutralise the shifting centre of gravity. This system is perfectly carried out in the Lanchester, owing to the position of the balance weights, which rotate in opposite directions and, in technical language, neutralise each other so far as their vertical component is concerned, but combine in respect of their horizontal component. The fact also that there are two fly-wheels instead of one on the Lanchester motor prevents that source of vibration which arises from the impulse given to the fly-wheel by the explosion of the charge; and as the Lanchester fly-



FRONT VIEW OF LANCHESTER MOTOR

FIG. 1

FIG. 2

LANCHESTER VALVE GEAR

wheels receive their impulse in opposite directions, the impulses are so neutralised that no shock is transmitted to the frame.

Another original feature of the Lanchester engine is its valve gear. In the engines hitherto described, it will be remembered that there have been always two valves—an inlet valve and an exhaust valve. The Lanchester patent valve gear, however, has only one opening into the combustion chamber instead of two; and one advantage of this arrangement is that the cool charge of unexploded vapour passes through the same valve as that by which the hot exhaust has escaped, and so keeps the temperature of the valve down and prevents the corrosion of its seat. The trouble of grinding-in valves, which has to be faced with ordinary engines after every 1,000 miles or so, is practically unknown in the Lanchester engine. Figs. 1 and 2 show in section the Lanchester valve. In Fig. 1 the valve is shown open for the passage of the exhaust gases, and in Fig. 2 it is shown with the exhaust aperture closed and the feed part open; the arrows in both figures show the course either of the vapour or of the burnt gas. The main valve is operated by a lever worked off the half-time shaft, and the feed is worked by a separate lever by means of an inertia governor, which acts, or fails to act, according as the speed is under or over that for which the governor is set. This governor acts absolutely by cutting out the mixture when the speed is excessive and re-admitting it when the speed drops again to the fixed limit. It acts on the feed-valve stem, which is furnished with a knife-edge and actuated by the governor blade. When the blade engages, a new charge of mixture is admitted to the engine, and when the blade fails to engage, no charge is admitted.

The Lanchester system of magneto ignition is also interesting and original, as it entirely dispenses with wire connections and has no trembler. The permanent magnets are built up to form part of one of the motor fly-wheels, in which their weight is utilised instead of being merely a burden. The armature is fixed in a relative position on the motor frame, and is supported by the motor crank shaft. The current is induced in the armature coils by the passage of the revolving magnet, which breaks the magnetic circuit. In the accompanying diagram the shaded portions represent the "earth" connections, which are all in connection with the motor frame, and therefore, of course,

with one another. The spark is produced by the primary coil of the armature in conjunction with a positively actuated contact-breaker.

This contact-breaker is an extremely ingenious piece of mechanism. Its construction is shown in Figs. 3 and 4. In these figures the projection described as the "tweaker" is attached to and revolves with the half-time shaft of the motor, and touches the igniter spring at every two revolutions of the main shaft. It is the action of this "tweaker" upon the igniter

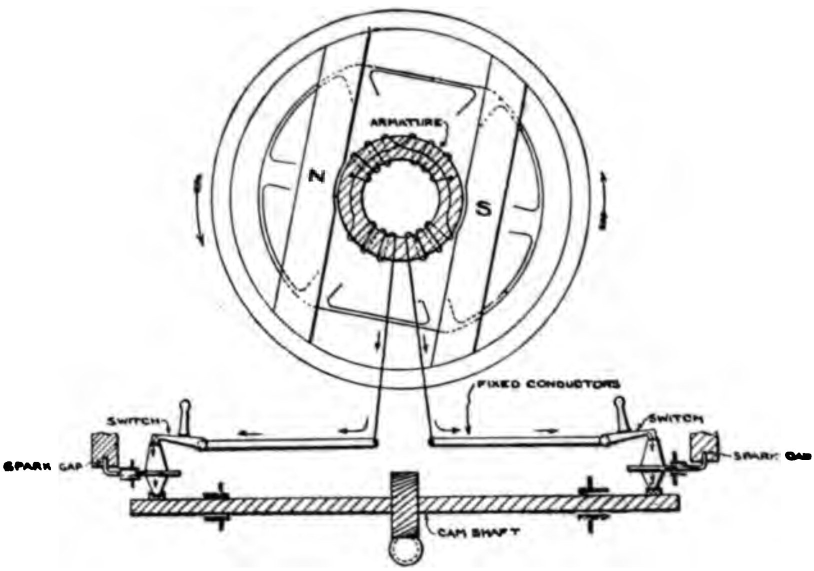


DIAGRAM OF MAGNETO AND ELECTRICAL CONNECTIONS

wire which causes the rupture of the circuit by which the spark is produced. The tweaker making contact with the igniter spring immediately closes the magneto electric circuit, and closes it again (in parallel) by a second path at the sparking gap within the cylinder. It will be understood that, while the second contact is always clean, the internal one may be so dirty as to offer a high resistance, which would in the ordinary way prevent a proper spark being formed. When the tweaker releases the spring the external clean contact is "ruptured" first and the internal contact immediately afterwards; the result being that the current has to pass by the internal contact for

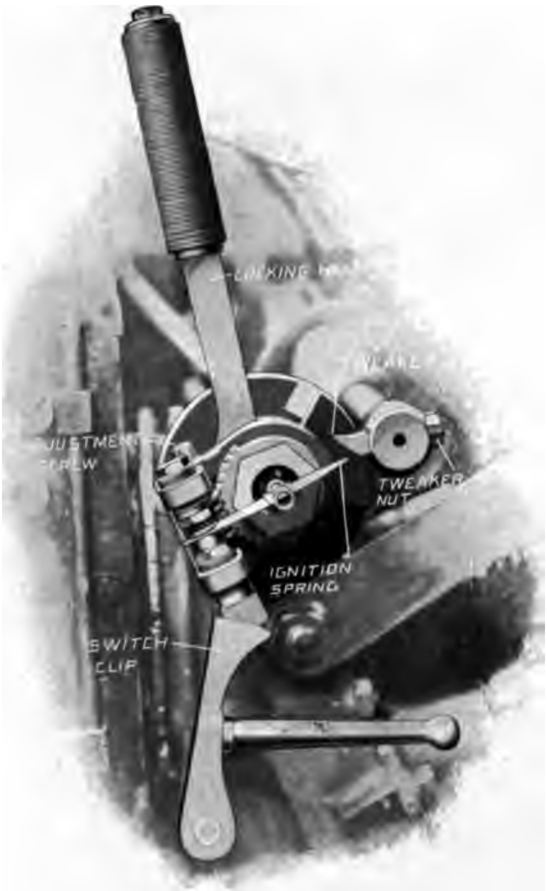


FIG. 3
LANCHESTER IGNITION MECHANISM

FIG. 5
LANCHESTER LUBRICATION SYSTEM

such a short period that its resistance (in other words, the cleanliness of the internal contact) is a matter of practically no moment.

The lubrication of the Lanchester engine is entirely automatic. All that the driver has to do is to see that the tank, which holds enough oil for about 150 miles' run, is kept full. The action of the lubricator is shown in Fig. 5, the pistons being lubricated by oil passing through the pillars which support the tank. Brass tubes also carry oil to the main bearing, cranks, and counter-shaft. The counter-shaft lubrication is from a small intermediate oil reservoir which is flushed at

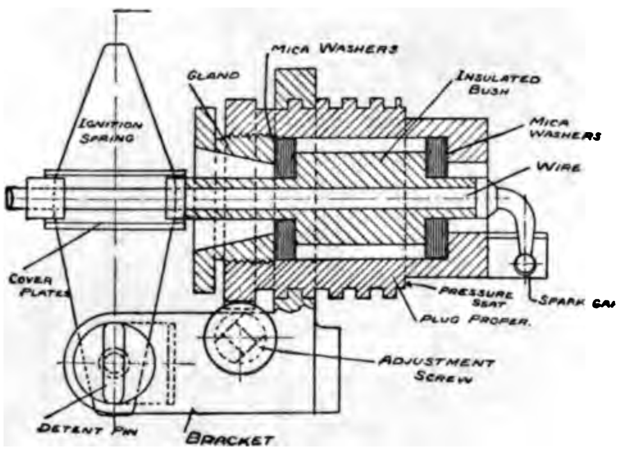


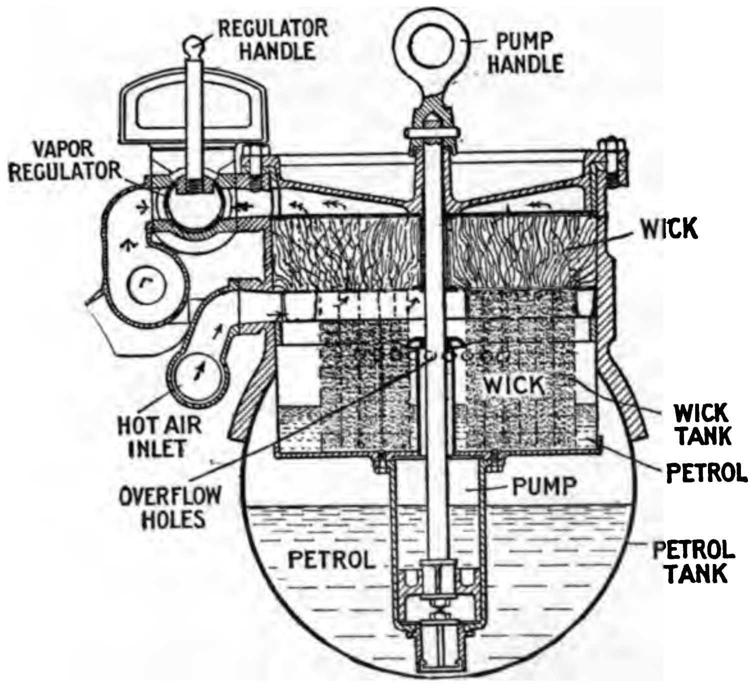
FIG. 4. LANCHESTER SPARKING PLUG AND IGNITION SPRING

intervals by a feed from the main tank, and discharges its contents to lubricate the counter-shaft.

Lanchester motor-cars are at present fitted either with air-cooling or water-cooling. In the air-cooling arrangement, which is the original Lanchester design, two aluminium fans are driven by friction off the rim of the motor fly-wheel, the frictional contact being maintained by springs. The fans act by suction and draw the air from the flanges of the cylinder-jacket into a wind-chest and thence into the centre of the fan. The air current induced by the fans is assisted by wind-scoops outside the car, through which air is passed when the car is running. In the water-cooled engines the arrangement is the

usual one: a radiator is placed in front of the car, and the circulation of the water is maintained by a gear-pump driven off the motor crank shaft.

The Lanchester carburettor is made under the company's own patents, its original feature being the use of a wick-feed for the purpose of avoiding the fractionating of the oil, *i.e.* the lighter constituents of the oil being made volatile and drawn off,



THE LANCHESTER CARBURETTOR

leaving the heavier residue in the oil-container. The advantage of the wick in the Lanchester carburettor is that as it draws up oils irrespective of their density, and as the volatilisation takes place from the upper portions of the wick, oil is vaporised in exactly the same proportions as exist in the tank, and it is claimed for the mixture that it is more constant in quality than with even the best spray carburettor. The drawing on this page shows the Lanchester carburettor. A draught of warm air is carried through the wick-chamber on its way to the

FIG. 6

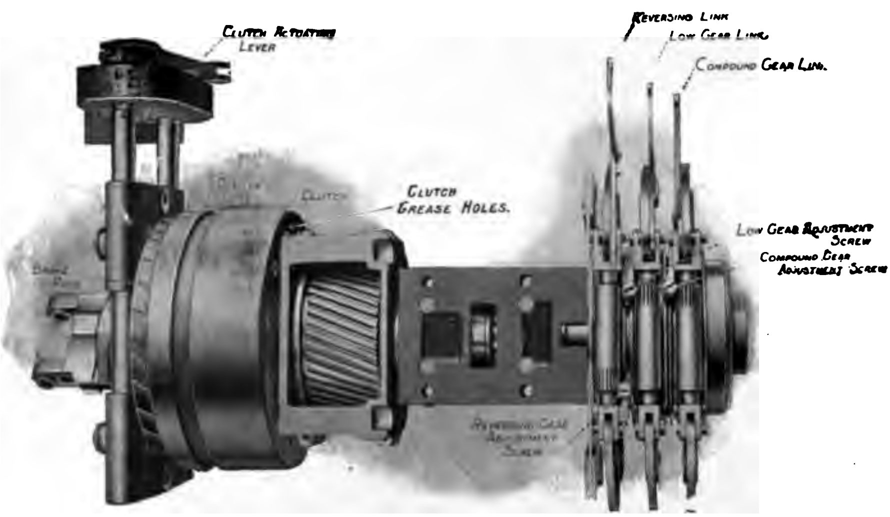


FIG. 7

LANCHESTER COUNTERSHAFT

motor-cylinder, and does not come into contact with the petrol itself at all, but only with the vapour given off by it. The single-headed arrows show the passage of the warmed air, and the double-headed arrows that of the carburetted air, which, passing into the vapour-regulator, is mixed with cold air to form the explosive mixture. The tank from which the wick sucks the petrol is placed inside the main petrol tank, a pump being arranged for filling the wick tank and an overflow being provided, so that if too much petrol is pumped up it flows back into the main tank. The pump-handle is at the driver's left hand, and a few strokes of the pump are required every ten or fifteen miles, and the main tank is fitted with a patent gauge to show the amount of petrol contained in it.

The counter-shaft of the Lanchester car is a self-contained piece of mechanism, carrying five distinct parts, namely, brake, high gear, reversing gear, low gear, and compound gear. It is carried by a bracket bolted to the underside of the motor bed-plate. It is driven off the lower motor crank shaft by means of helical gearing, and its general construction is shown in Figs. 6 and 7. The change-speed gear is contained in the drums shown at the right hand of the illustration, and the clutch and brake are at the other end. The helical wheel is enclosed in an aluminium case and runs constantly in oil. It is keyed to a hollow shaft which runs in bearings in the bracket, and contains bolted on to it the outer or female element of the cone-clutch. The clutch or male part of the cone is in sliding connection with the centre shaft, which passes through the hollow shaft and engages with the change-gear mechanism on its front end. The mechanism employed for sliding the clutch-cone is shown in the illustration, and consists of two parallel shafts, which engage with projections fitted under and over a ball-thrust block mounted on a sleeve to which the clutch is attached. The whole mechanism is controlled from the driver's seat by the high-gear lever.

The change of gear is effected by three separate trains of epicyclic gear, the reverse being obtained by connecting the outer element to the centre shaft. Both brake and clutch surfaces are made of cast-iron, engaging with cast-iron, no leather or composition being employed, so that there is no danger of firing from a continuous use of the brake. Before

describing the action of the gears in detail it may be pointed out that the three trains of gearing are practically identical as to the dimensions and arrangements of their elements. The pinions, bearings, etc., of the three sets are interchangeable. The functional difference of all three sets is brought about entirely by their coupling up to their respective brake-drums and to each other.

Diagram (a) shows a diagrammatic epicyclic gear * in which the three portions are labelled respectively "Inner Element," "Outer Element," and "Star Element," the star element being

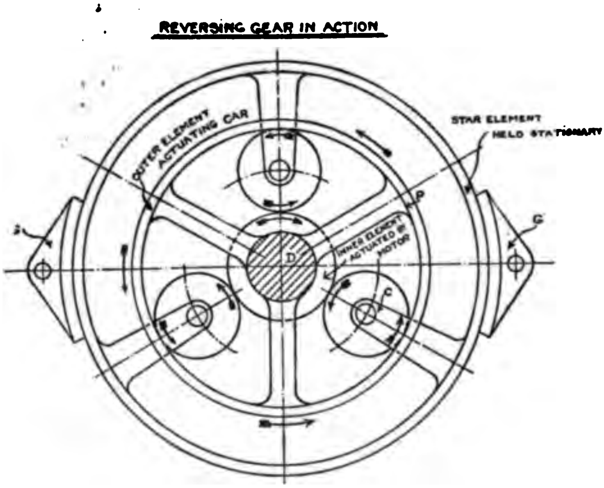


DIAGRAM (a)

the one which carries the planet wheels. In the reversing gear the inner element consists of the hollow shaft C, which is in running connection with the motor, while the outer element P is in positive running connection through the shaft D with the propellor or driving shaft of the car. The star element is attached to a brake-drum, which is operated on by brake blocks in order to put the reversing gear in action. When the star element is brought to rest by the application of its brake its pinion bearings become fixed, and the pinions, revolving simply on their bearings, transmit motion from the inner element to the outer element with a consequent reversal in the direction

* See page 64.

of motion and an appropriate reduction in speed. This is indicated in the figure.

To understand the working of the low and compound gears respectively it must be remembered that when the counter-shaft clutch is in action the whole gear-box revolves *en bloc.* There is under these conditions absolutely no relative motion between the component parts of the train of gear; they go round as one solid piece. In the diagram (b) we have a diagram of the low gear running idle. It will be noted that the outer element constitutes the low-gear brake-drum, and that when

LOW GEAR IDLE

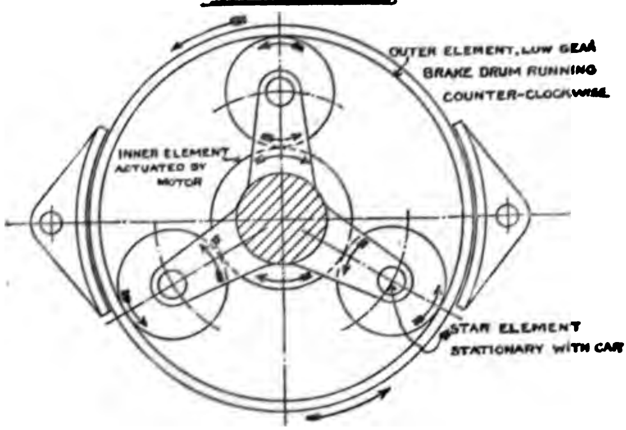


DIAGRAM (b)

the gear is idle this runs in a backward direction and the car is standing still. We have, then, two limiting conditions and an intermediate condition :—

1. When the car is at full speed (on the direct clutch) the low-gear drum runs in a forward direction.

2. When the car is at rest the low-gear drum goes backwards.

Consequently when the low-gear drum is held stationary, the speed of the car is about midway between that of the high gear and zero. The proportions given to the working parts are such that the ratio of high gear to low is approximately four to one.

In the diagram (c) the low gear is shown in action. The low-gear inner element connected with the motor is running in a forward direction. The low-gear star element is, as we have seen, moving forward at a slower rate. The low-gear drum is held stationary by its brake. Now the compound gear pinions are mounted on pins fixed to an extension of the low-gear drum (this is shown in a purely diagrammatic form). These pinion bearings are consequently stationary, and we

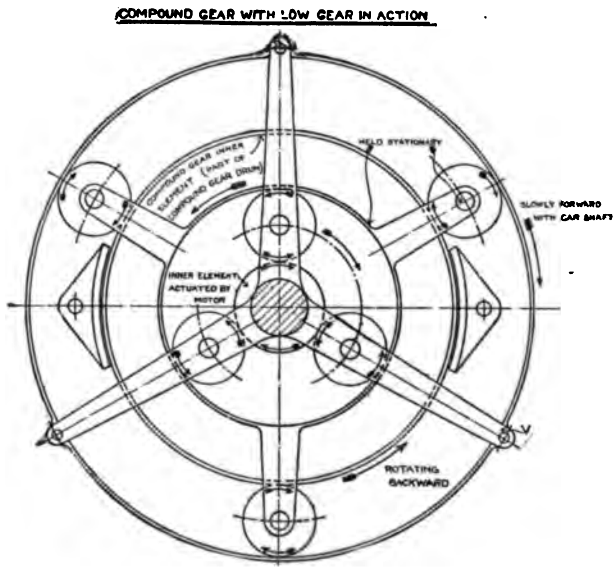


DIAGRAM (c)

have the compound gear inner element (to which the compound gear-drum is attached) rotating backwards. Again, then, we have two limiting conditions and an intermediate.

1. When the car is on the high gear the compound gear-drum runs in a forward direction.

2. When the car is travelling with its low gear in action the compound gear-drum goes backwards.

Consequently, if we hold the compound gear-drum stationary (by means of its brake) the car will go at a speed intermediate between the high gear and the low gear. The actual speed

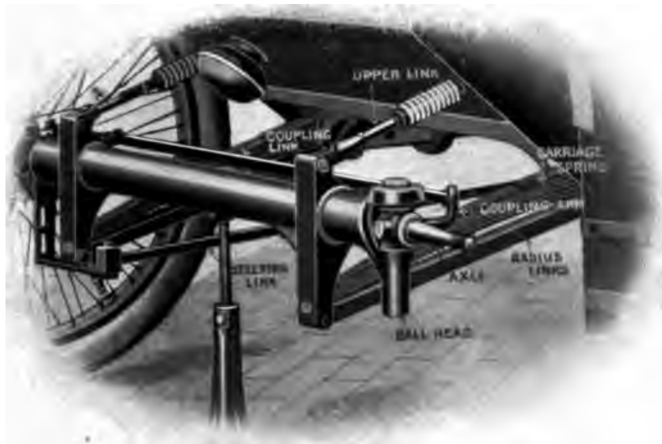


FIG. 8

ILLUSTRATING LANCHESTER SYSTEM OF SUSPENSION

LANCHESTER TOURING CAR, WITH DETACHABLE BROUGHAM HEAD

ratio of high gear to compound is approximately as seven is to four.

Not the least important part of the Lanchester car in the eyes of the amateur is its remarkably graceful and rakish appearance and the extreme comfort of the carriage. This is achieved partly by the general design of the car, which permits the carriage to be hung so low that the centre of gravity is kept well down, and partly by means of the beautiful suspension arrangement by which the car frame is connected to the under frame. Instead of the ordinary double type of carriage spring, a single spring like a cantilever is used at each of the four suspension points, half of each spring being outside and half inside the frame of the car body. In Fig. 7 this system of suspension is illustrated. One great advantage of this, both for steering purposes and general comfort, is that the car, instead of tending to roll along over its front axle, thrusts it forward, and lies well behind the point of contact of the wheels with the ground.

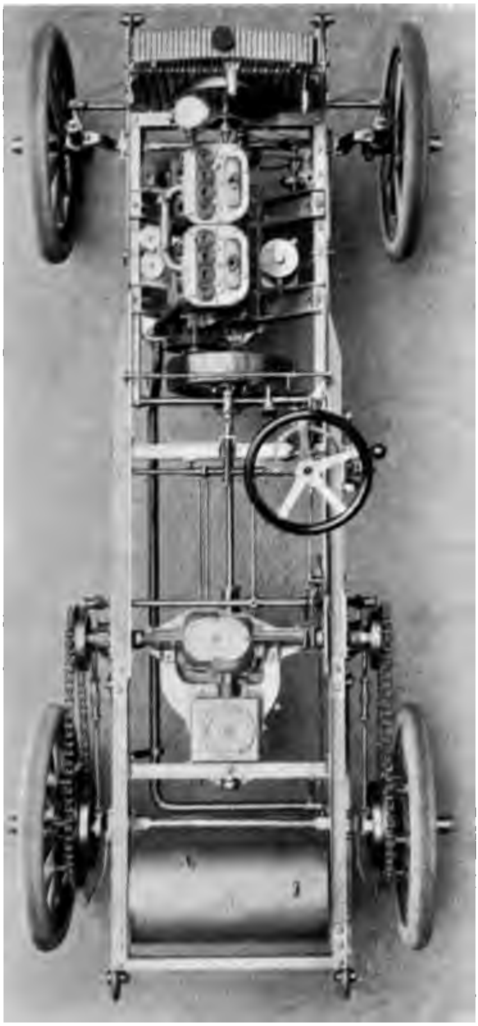
My own impression of the Lanchester car is that, given proper attention and the moderately careful use which all machinery demands if good results are to be obtained from it, there are few motor-cars better suited for the use of private travellers on our English roads. The great comfort of the carriage, its beautiful lines, its "gentlemanly" appearance, the sterling qualities of the work employed in it, and its general strength and durability are qualities that recommend it powerfully to those motorists who care more for comfort than for speed, and who yet wish to be able to cover the ground at a reasonable pace. The lower-powered Lanchester is not a racing car, nor is it a particularly fast hill-climber; but the ease with which it is controlled and the very respectable average speed which it can steadily maintain make it a charming vehicle for people who like to see something of the country through which they have to pass, who do not wish to have their minds occupied entirely with details of machinery, and who like to travel in comfort and at a moderate cost. The silent working of the Lanchester car makes it also an extremely useful carriage for town use, especially when it is fitted with the detachable brougham head shown in the illustration.

THE DAIMLER CAR

The Daimler Motor Company has earned for its cars a deservedly high reputation. It was the first company formed in England for the manufacture of motor-cars, and since its first car was made its good name has steadily increased. Thoroughness and soundness of workmanship have from the first been characteristic of Daimler carriages, and the company has always regarded strength and durability as more important qualities in a motor-car than mere speed and cheapness. The result has been that, although these cars are slightly heavier than the average, and not quite so fast per horse-power as some of their rivals, the users of them have always enjoyed a feeling of confidence and freedom from breakdown on the road.

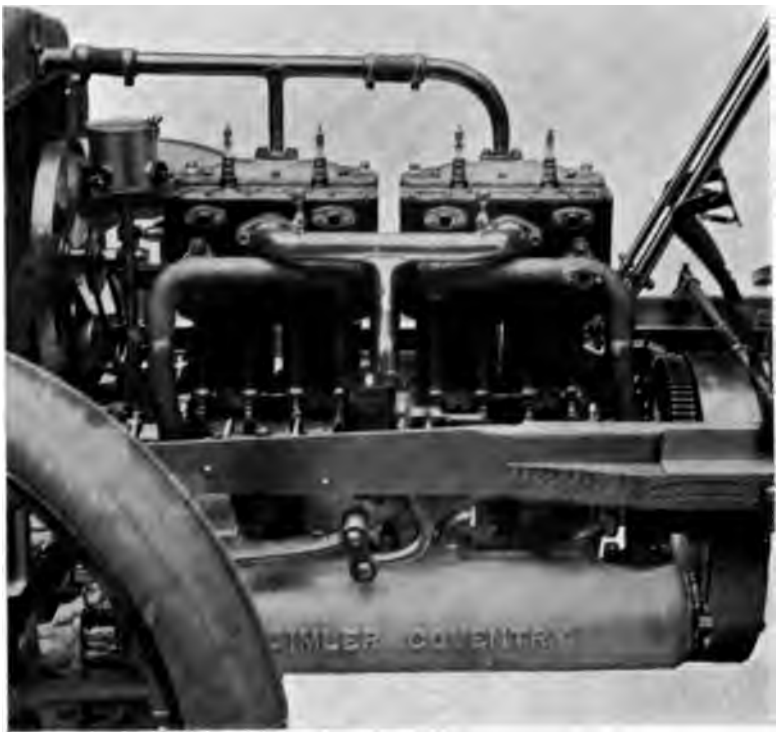
The Daimler cars are built on standard lines, with a vertical four-cylinder engine under the bonnet in front driving through a gear-box to a counter-shaft fixed across the car, and from this the rear wheels are driven by means of outside sprockets and chains. The engine is water-cooled by means of a radiator and fan with a large centrifugal pump to maintain the circulation. The 1904 Daimler engines are built in three sizes—16 h.p., 18 h.p., and 28 h.p., all these engines being identical in design, and different only in dimensions. These figures are, however, somewhat misleading, as the large range of speeds at which the Daimler engine may be run allows of a much greater horse-power being developed when the engine is accelerated. Thus the 16 h.p. engine can develop 20 h.p., the 18 h.p. can develop 22 h.p., and the 28 h.p. can develop as much as 36 h.p. The 18 h.p. and the 28 h.p. cars are supplied either with a short or a long chassis, the standard length of these allowing for wheel bases of 8 feet, 9 feet 6 inches, or 11 feet. A great variety of bodies can thus be fitted; and this practice allows for the greatest possible variety in external arrangement, while it keeps the actual engines built by the company within the limits of two or three standard sizes.

The accompanying views of the engine and chassis are taken from a 28 h.p. car of the 1904 pattern, but the details are similar in all three sizes. The frames are constructed of steel plates combined with wood and channel steel, narrowed in front, but without weakening the side members; and no under

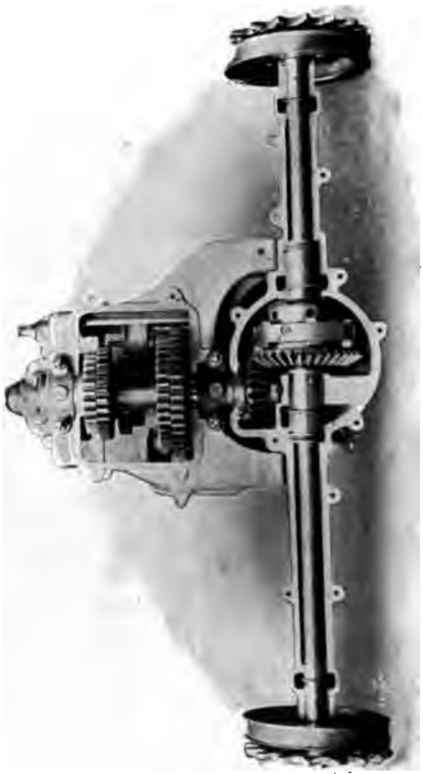


THE DAIMLER CHASSIS, FROM ABOVE

THE DAIMLER ENGINE. RIGHT-HAND SIDE



THE DAIMLER ENGINE, LEFT-HAND SIDE



DAIMLER CHANGE-SPEED GEAR AND DRIVE

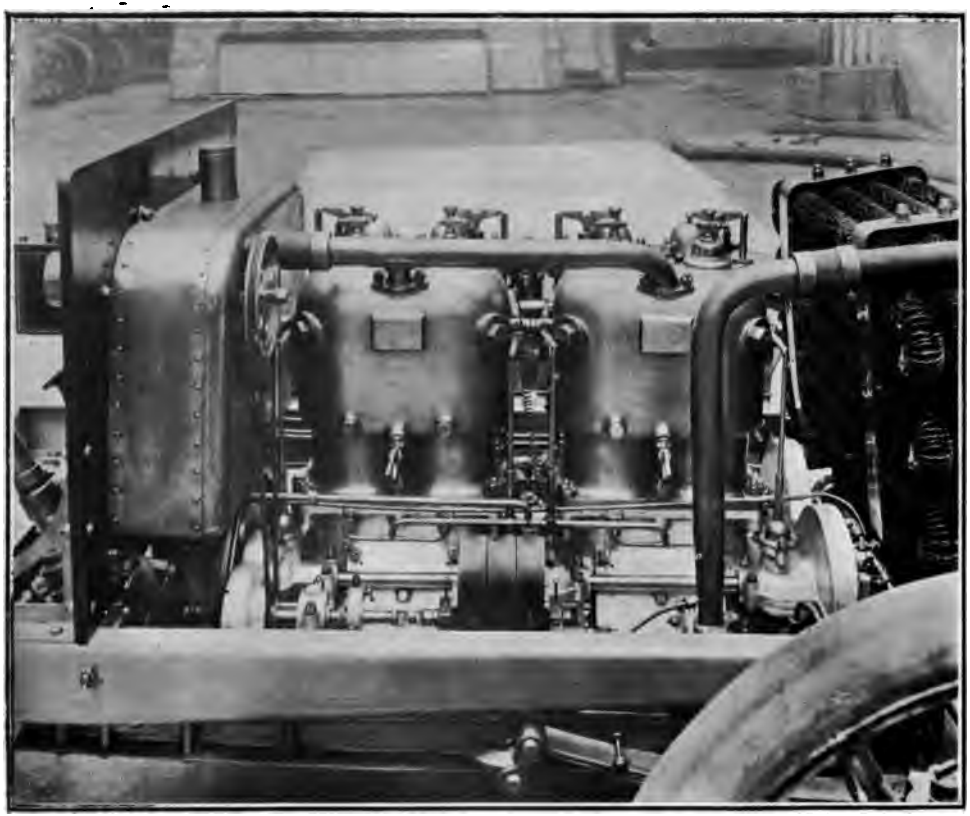
frame is used. The engine has four cylinders cast in pairs, those of the 28 h.p. engine having a bore of 110 mm. and a stroke of 150 mm.; and this engine develops the advertised horse-power at 750 revolutions per minute. The valves, mechanically operated, are all placed on the left-hand side of the engine, and an automatic governor throttles the supply of gas to the cylinders upon a given engine speed being attained. The carburettor, of the spray type, is a special design of the makers, and gives a positive regulation of mixture at all loads and speeds of the engine; combined with it is a graduated throttle, which is actuated by the automatic governor as well as by a hand control. The ignition is on the high-tension system, with one coil and trembler and one low-tension timing brush; but the high-tension magneto system is fitted as an extra for those who desire it. All bearings are self-lubricating, except those supplied by the sight-feed pressure lubricator to the engine cylinders and crank chambers. The clutch is a light cone covered with leather, and controlled by a pedal in the usual way; the shaft which revolves with it communicates direct with the gear-case, which is combined with the casing enclosing the differential shaft. The Daimler change-speed gear, which is illustrated, provides four speeds and a reverse, which are controlled in a somewhat special way. Instead of one lever working in a notched segment, through different portions of which it has to be moved to effect different changes of speed, the Daimler system allows of a full movement of the lever to be made for each change, two segments being fitted side by side, in each of which the lever is able to work. The reverse gear is actuated by a separate lever. The brakes are of the external band type; one pair operates on drums placed on each side of the differential shaft, which are operated by a pedal; the other pair act on the rear wheels, and are controlled by a hand lever. The bands are of soft iron rubbing on steel drums, and require no water cooling. The steering is by wheel with a worm and segment gear; the wheels are of the artillery pattern, all four being 36 inches in diameter; and the axles are of solid steel with vertical swivels and forged steel axle hubs and naves; all journals are case-hardened. The prices of Daimler cars are from £700 upwards, according to the type of carriage fitted.

THE DE DIETRICH CAR

No motor-car has in so short a time earned so high and worthy a reputation as the De Dietrich. Like most of the cars which share with it the highest place in modern motor-car construction, it is the result of long and elaborate study on the part of an engineering firm of world-wide fame. The name of the Dietrich Company is famous in the science of metallurgy as well as in commerce, and it is natural that when such a firm, like the Cannstatt Daimler Company and Crossley Brothers, turns its attention to the making of modern high-speed road-carriages, it should achieve something far out of the common both in design and workmanship. The remarkable performance of the De Dietrich car driven by Mr. Jarrott in the Paris-Madrid race in 1903, which covered the 343 miles to Bordeaux in 351 minutes, is only one of the many successes recently won by these cars on the road; and they have won still greater successes in the less conspicuous but more important contest of utility and durability that is provided in the daily experiences of private owners.

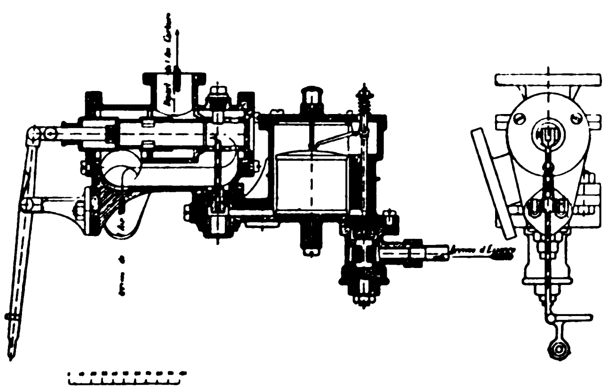
Perfection of workmanship rather than originality in detail is what seems to be aimed at by the Dietrich Company, although many details of construction, hardly important enough singly to attract attention as innovations, show with what care every detail is thought out and adapted to its purpose. The De Dietrich car is constructed on the modern standard lines. A pressed steel frame carries the carriage work and springs, while the motor itself, of the four-cylinder vertical type, is hung in a steel cradle in the forward part of the frame. The usual long springs both before and behind carry the chassis upon the road wheels. The steering gear works by an inclined wheel, and is provided with a tooth-nut by means of which any wear can be taken up, and it is fitted with ball connections which make its movements smooth and easy. The motor consists of four vertical cylinders cast in a single piece with the water-jacket; piston-rods, bearings, distributing gear, cams, and regulators being enclosed in a dust-proof case and running in oil. The inlet valves are mechanically operated and placed on the top of the cylinders. The ignition is by a gear-driven Simms-Bosch magneto on the low-tension system. The timing of the ignition

24-H.P. DE DIETRICH CAR



RIGHT-HAND SIDE OF DE DIETRICH ENGINE

is regulated by a lever on the steering wheel, and there is a special arrangement whereby any given cylinder can be cut out of the electric circuit in case of a fault. In addition to the mechanical control of the spark from the driver's seat, it is automatically advanced and retarded in accordance with the speed of the engine, so that even in careless and inexperienced hands back-firing is impossible, as well as knocking and damaging the engine by running with the spark too far advanced. The carburettor, of the spray type, is quite automatic in its action, and preserves an exact balance of the mixture in proportion to the speed of the engine. The jet of petrol is pulverised by a double current of air, and the supply, as well as being

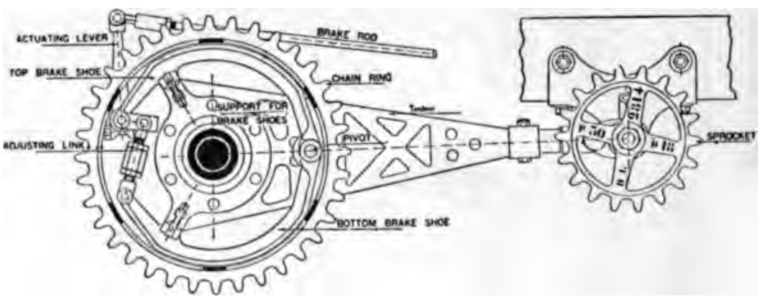


DE DIETRICH CARBURETTOR

automatically governed, can be throttled by hand by means of a lever on the steering wheel, this, as in the case of the Mercédès, ensuring very quiet running of the engine at low speeds.

The De Dietrich system of transmission follows the standard practice; a friction clutch mounted on a sleeve is connected to the gear-box by means of a universally jointed shaft, and four speeds and a reverse are provided in the usual way by toothed wheels of different sizes on the engine-shaft engaging with corresponding wheels on the secondary shaft. The secondary shaft drives to the differential shaft by means of a bevel gear, and the motion is transmitted to the road wheels by side sprockets and chains. Ball-bearing thrust-blocks are employed

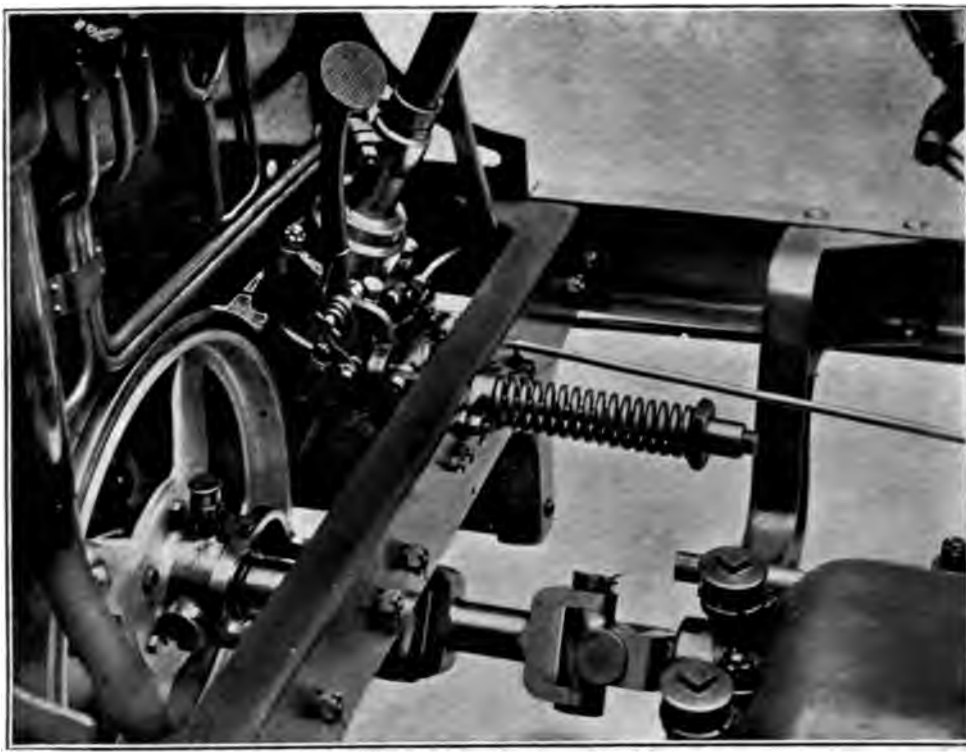
to reduce friction to a minimum ; and all four speeds and reverse are controlled by a single lever placed in a quadrant at the driver's right hand. A drum is mounted on the differential shaft containing a powerful expanding brake worked by a pedal, and the brakes on the drums of the rear wheels are of the same pattern. The whole of the gear mechanism is enclosed and runs in oil. The case enclosing it has only one horizontal joint ; and when the upper half is removed the shaft, gearing, clutch, and differential can all be taken out without any further opening up of the mechanism. This accessibility of the parts—a very important point—is carefully studied throughout the De Dietrich car, not only on the engine itself, but, as I have just shown, in the gear-case and also in the clutch mechanism, the



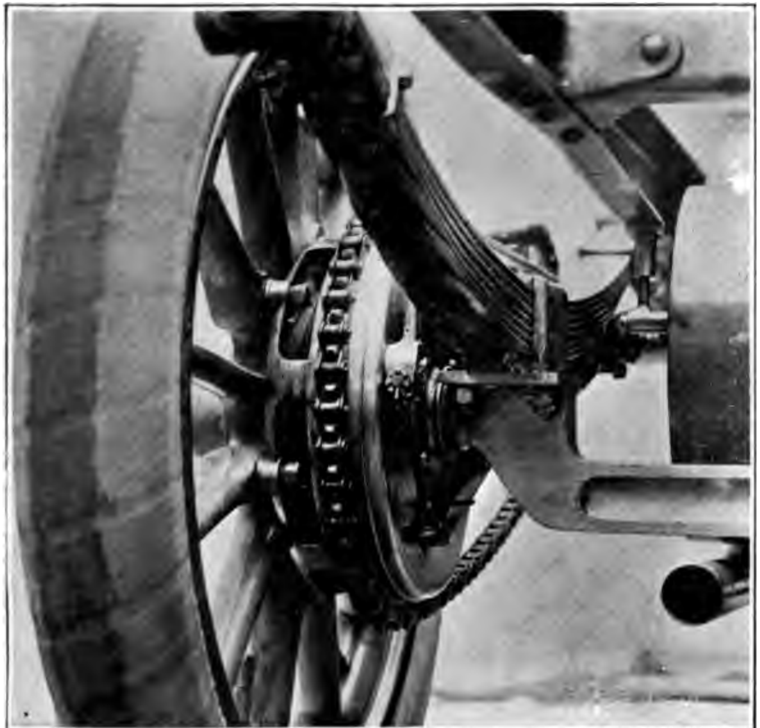
DE DIETRICH EXPANDING BRAKE

clutch spring being situated immediately beneath the footboard, where it is within reach at once.

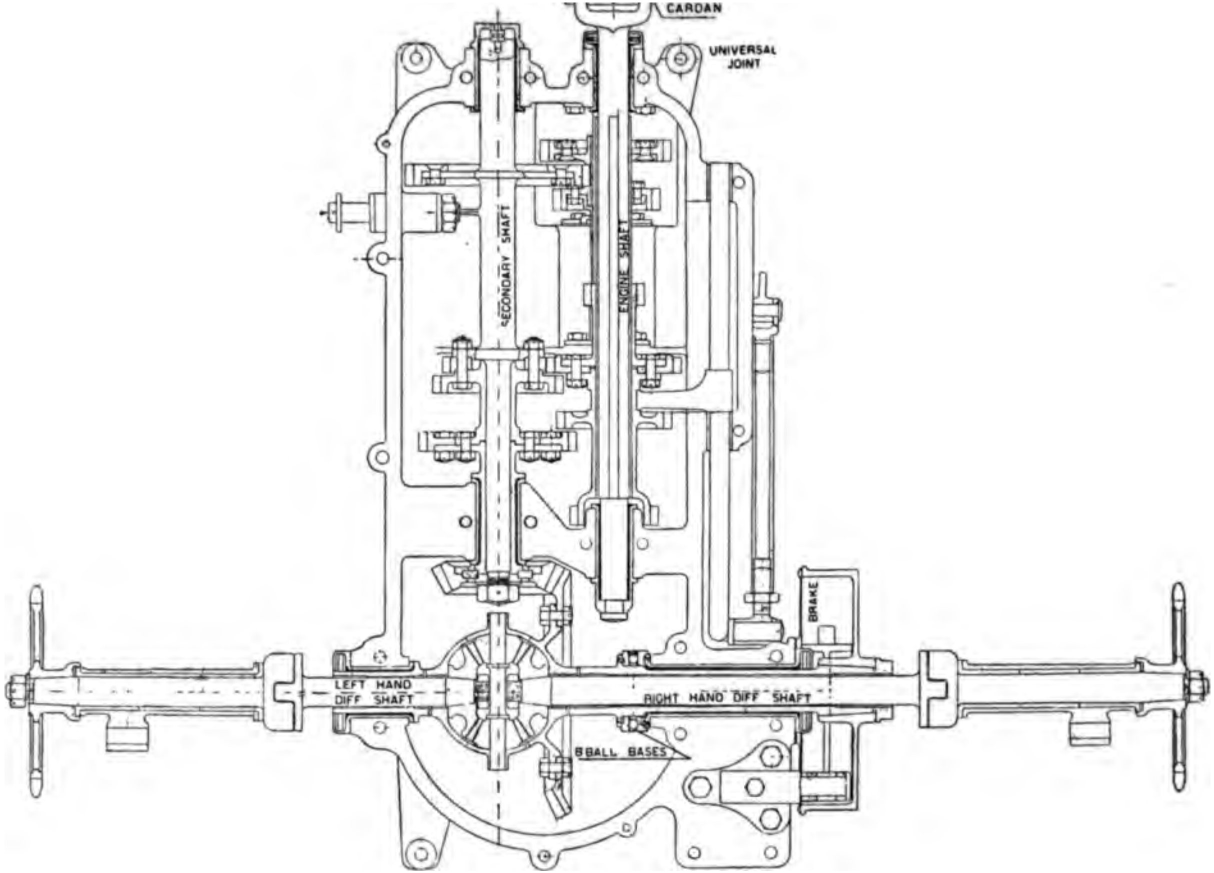
The cooling of the engine is by means of a large centrifugal pump driving water from a tank on the dashboard through the cylinder jackets and a large tubular radiator placed in front of the bonnet. It is worthy of notice that the Dietrich Company have refused to follow two of the principal fashions in motor-car construction prevailing at present—the honeycomb radiator, and the direct drive on the top speed—and that they have rejected these devices solely because they claim better results for the older systems. Much of the success of their water-cooling system, however, is due to the exceptionally large gauge of piping employed in it, and also to the fact that, although circulation is promoted by means of a large centrifugal pump, it is so arranged that, should the pump fail, circulation will be



DE DIETRICH CLUTCH SPRING AND CLUTCH MECHANISM,
SHOWING UNIVERSALLY-POINTED SHAFT



DE DIETRICH REAR SUSPENSION



DE DIETRICH CHANGE-SPEED GEAR

maintained on the thermo-syphon system. It is claimed that the car can be run 1,000 miles with the loss of less than half a pint of water. The water-jackets of the cylinders are fitted with taps out of which the whole of the water surrounding the cylinders can be drained. It need hardly be said that such a matter as lubrication is very carefully and exactly worked out, the lubrication of the engine being secured by an automatic drive, which supplies oil in exact proportion to the needs of the engine according to the speed at which it is running.

A close examination of the De Dietrich car is in itself an education in the scientific adjustment of weight and strength. The accompanying illustration, for example, might surprise the amateur, because of the apparently excessive size and strength of the rear springs and the apparently insufficient weight and strength of the rear axle. Yet this rear axle is one of the strongest used in motor-car construction, and the suspension of the De Dietrich car is remarkable for its lightness and comfort. The design of the rear axle shows how carefully strength has been concentrated on the point on which the chief strains are thrown, and weight economised where strength is not so much needed. The De Dietrich cars are supplied in various forms and with engines of 12, 16, 24, 35 nominal h.p.; the effective h.p. of these being about 14, 18, 28, and 40 h.p. respectively.

THE WOLSELEY CAR

The cars made by the Wolseley Tool and Motor-Car Company, Limited, are typical throughout of English rather than of Continental engineering practice. They have earned golden opinions for their power, simplicity, and freedom from breakdown; while almost alone among motor-cars constructed by makers of repute, they represent the really practical touring-car which is sold at something like a moderate price. They are equipped with engines of 6, 8, 12, 16, 24, 32, 72, and 96 h.p.; the 6 h.p. car is dealt with in the chapter on light cars, while the 8, 12, and 24 h.p. cars are the most popular among private users. The 12 h.p. car, which is sold complete at £400, is among the best of

12-H.P. WOLSELEY CAR

value in English-built motor-cars that can be obtained for that sum.

The Wolseley principles of construction are in many respects unique. The engine, instead of being placed vertically under a bonnet in front of the car, lies horizontally immediately in front of the dashboard, the crank shaft being parallel with the axles of the road wheels, and therefore involving less loss in transmission than is the case with motors which transmit their power through a right angle. Moreover, less head room is needed for the horizontal position, and the space thus saved is utilised for water and petrol tanks. In the cars of 8 and 12 h.p. the engine consists of two cylinders lying side by side; in the larger cars four cylinders are used, which are arranged in opposed pairs. The cylinders consist of two separate parts. The body of the cylinder proper is a cast-iron liner fitting into the aluminium crank chamber and water-jacket. The head—containing the vertical valves and ignition-plug—is a separate casting, with a separate water-jacket, and is bolted to the aluminium casting. The crank chamber is fitted with an inspection cover and also with two apertures covered with gauze, through which the air is allowed to circulate. The inlet valves are automatic, and the exhaust valves are operated by cams on a cam shaft situated immediately beneath the crank shaft, and driven from it by means of spur wheels. Arrangements are made to prevent oil in the crank chamber from escaping along the levers and shafts. An arrangement is also fitted by which additional cams are brought into play on the starting up of the engine to relieve the compression in the cylinders by means of a lift upon the exhaust valves.

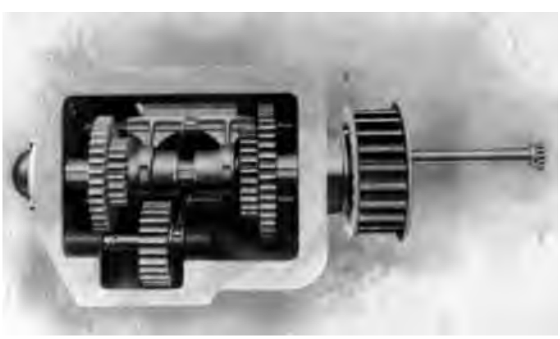
The horizontal position of the engine, and the fact that the crank shaft lies across the frame, brings the starting handle to the side of the car instead of in front of it. The starting handle, which is inserted in a fitting just under the dashboard, engages with the crank shaft itself, and close to it a handle is provided for bringing into action the half-compression cam. A special type of radiator is used on the Wolseley cars. This consists of a series of radiator pipes, stepped in the manner shown in the illustration, which communicate with side tanks or bottles containing the main supply of water. A large rotary pump is driven direct from the cam shaft by gears. It is

situated at the lowest point of the cooling system; and as the whole of the radiators and tanks are at some height above the motor, automatic circulation is maintained in the event of the pump breaking down. The ignition is on the ordinary high-tension system, and the commutator is conveniently placed at the side of the car near the starting handle, the timing of the spark being varied by a movement of the commutator by means of rods and levers from the steering pillar. The ordinary splash system of lubrication is not adopted on these cars, and in any case the horizontal position of the engine makes splash lubrication almost impossible. Independent pipes, therefore, lead from a lubricator on the dashboard to all the main bearings, and the centrifugal motion imparted by the crank shaft to the oil, combined with a system of channels and leads, is relied upon to effect the lubrication of the big-ends. Grease cups are fitted to the clutch, steering pivots, pump, and other parts which do not require a constant feed of oil. The petrol tank is situated in front of the dashboard, and a glass gauge is fitted to indicate the level; in case of breakage, this gauge can be cut out by means of a three-way cock. The carburettor is of the float-feed and spray type, and is fitted with two throttles, one of which is controlled from the steering pillar, and the other connected with the clutch pedal, thus acting as a simple and automatic governor, which throttles the engine immediately the load is withdrawn.

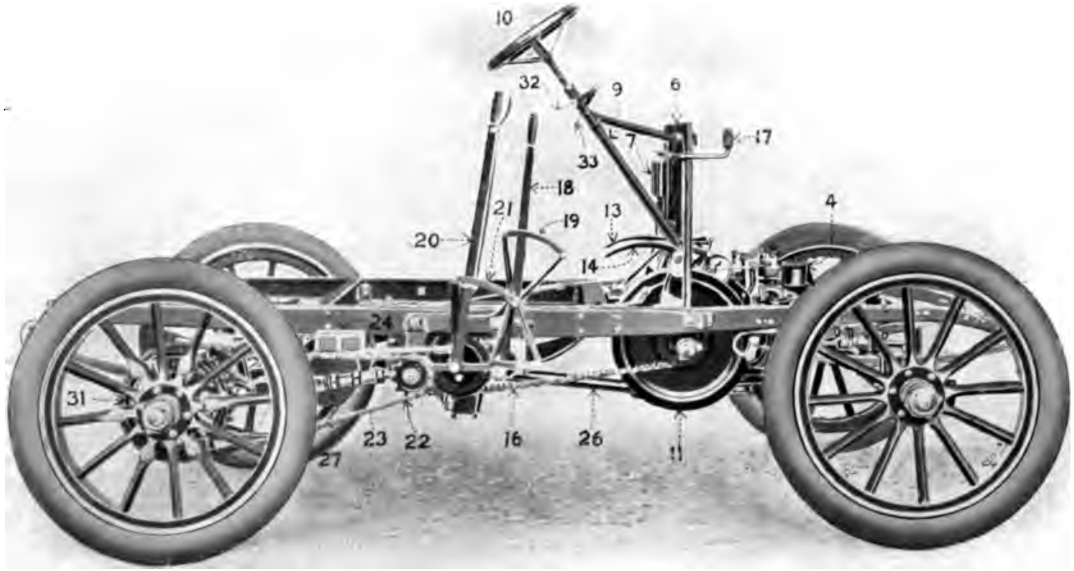
The Wolseley transmission is greatly simplified by the parallel position of the crank shaft and road-wheel axles. A cone-clutch is mounted on the outer end of the crank shaft to the extreme right of the chassis under the dashboard, and just outside the heavy fly-wheel. From the clutch to the first-motion shaft of the gear-box, which lies across the chassis just to the rear of the crank shaft, the transmission is by means of a Renolds silent chain; the gear-box itself, as will be seen from the illustration, is a comparatively simple one, the changes of speed being obtained by sliding gear-wheels. The gear-box is directly combined with the differential shaft, from the ends of which roller chains lead to the driving wheels in the usual way. There is thus what is practically a direct drive on all speeds. One lever controls all four speeds and a reverse. A patent catch on the lever makes each movement single and

12-H.P. DASHBOARD, SHOWING LUBRICATOR PETROL GAUGE AND CONTROL

REAR HALF OF WOLSELEY GEAR BOX

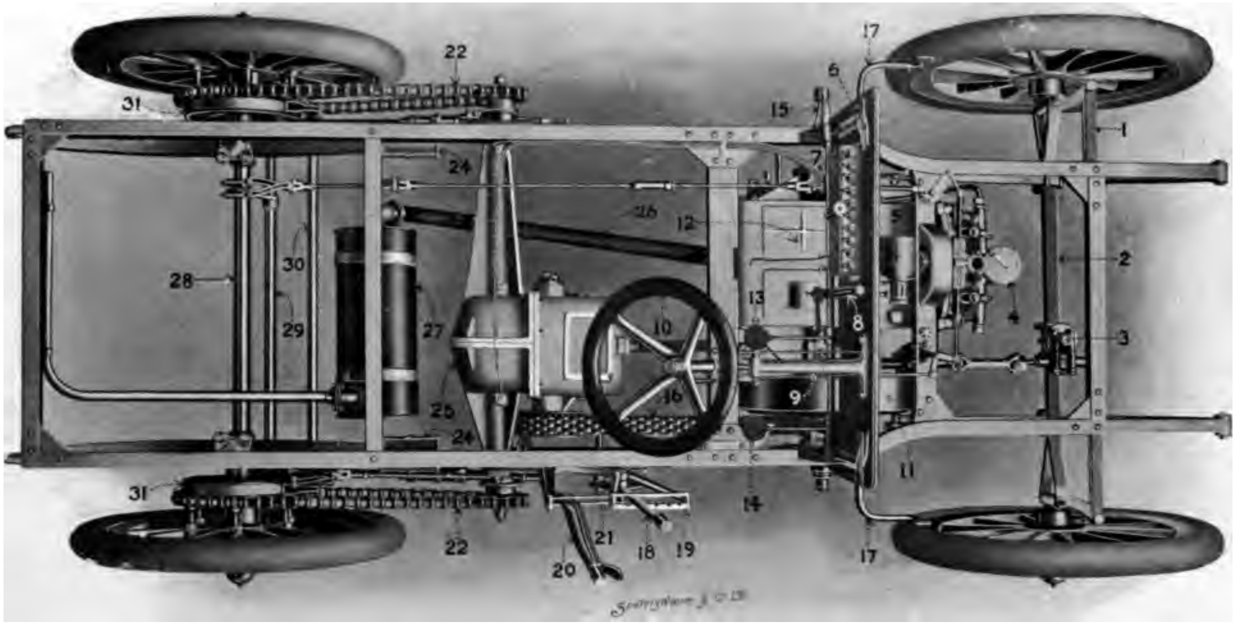


FRONT HALF OF GEAR BOX, SHOWING SLIDING GEAR



12-H.P. WOLSELEY CHASSIS

1—STEERING ROD
2—FRONT AXLE
3—WORM STEERING GEAR
4—FLOAT CHAMBER
5—AIR BOTTLE
6—DASHBOARD
7—OIL RESERVOIR
8—PETROL GAUGE
9—STEERING BRACKET
10—STEERING WHEEL
11—FLY WHEEL
12—CRANK CHAMBER
13—BRAKE PEDAL
14—CLUTCH
15—STARTING HANDLE BRACKET
16—RENOLD'S CHAIN
17—LAMP BRACKETS
18—GEAR LEVER
19—GEAR QUADRANT
20—BRAKE LEVER
21—BRAKE QUADRANT
22—ROLLER CHAIN
23—RADIUS ROD
24—SPRING BRACKET
25—GEAR BOX
26—EXHAUST PIPE
27— „ BOX
28—BACK AXLE
29—INTERNAL BRAKE ROD
30—BAND
31—REAR WHEEL BRAKE
32—THROTTLE LEVER
33—IGNITION „



12-H.P. WOLSELEY CHASSIS

A RENAULT CAR

positive, so that it is impossible for the driver accidentally to overrun one position of the lever and to put in a higher speed than he intends.

The brake system on the Wolseley cars differs from ordinary practice in that there is no brake acting on any of the gear shafts, the whole of the brake power being applied to the hubs of the road wheels. The foot pedal operates an internal expanding brake on these hubs, while the hand lever applies an external band brake to them. It must be remembered, however, that many cars possess both these brakes, with a brake on the differential in addition; and I am not sure that the designer of the Wolseley cars is right in abandoning this additional safeguard. The steering gear is of the worm pattern, the usual self-locking arrangement being fitted. The frames of the Wolseley cars are of pressed steel; and as the firm is in association with Messrs. Vickers, Sons, and Maxim, it may be taken for granted that such important parts as frames, axles, and crank shafts, which are supplied by Messrs. Vickers, are of the very highest quality. The fact that two Wolseley racing cars of 72 h.p and 96 h.p. respectively were chosen to represent Great Britain in the Gordon-Bennett Cup Race for 1904, and that both completed the course in very fast time, is an evidence of excellence both in design and workmanship.

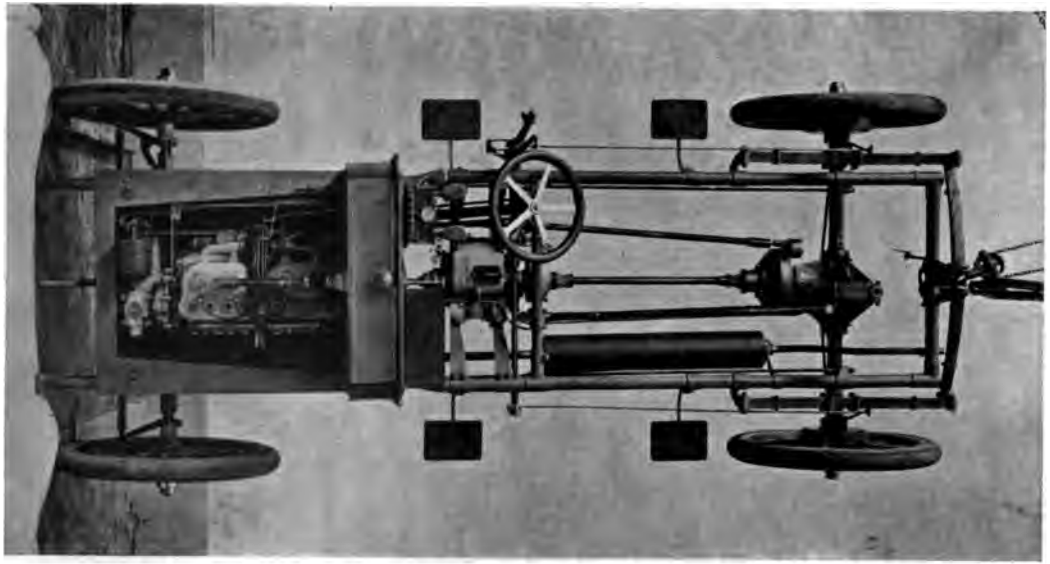
THE RENAULT CAR

The cars manufactured by Messrs. Renault Frères are interesting not only on account of certain originalities in the design of their mechanism, but also because of their consistent successes every year since 1899 in some of the principal road races held on the Continent. Outwardly the Renault cars do not seem to differ greatly from the standard type of modern automobile; but an examination of their mechanism reveals numberless small points that are either different from standard practice, or remind us that Messrs. Renault have been the pioneers in certain principles and devices which are now being adopted on an increasing number of other cars. Messrs. Renault were the first to apply the propellor shaft and live rear axle as a principle of transmission, and in this they have now many followers. Their cars are now made in three sizes;

the 7 h.p. car has a single-cylinder engine having two balanced fly-wheels, one fixed within the engine casing, and the other externally, in conjunction with the friction clutch. An automatic inlet valve is used, and a centrifugal governor acts upon the admission, an accelerator pedal being provided to throw off the action of the governor. The 10 h.p. car has a two-cylinder engine, also with automatic valves, the control of engine speed being obtained by a patent arrangement for varying the tension of the inlet-valve springs. On both these cars the ignition is on the high-tension system, the current being supplied by accumulators. On the 14 h.p. car, which embodies all the special features of Renault construction, a four-cylinder motor is used, the inlet valves in this case being mechanically operated and provided with a special device whereby the load can be varied. This progressive distribution of the four inlet valves allows of great variation of power, and extends the range of the motor considerably. Both inlet and exhaust valves are operated from the same cam shaft. Lubrication is mechanical and automatic. The outer end of the motor shaft is provided with a screw; this drives a worm which, by means of a connecting link, operates the lubricator on the dashboard of the carriage. The oil in the crank case is forced up by the rotation of the cranks into channels in the upper section of the gear-case, then flows into receptacles placed above each bearing. From these it passes into rings having annular grooves which communicate with the crank heads through holes bored in the crank shaft.

The water-cooling system of the Renault cars is quite unique. In earlier patterns the gilled radiators were placed on each side of the bonnet, but this position was found to interfere with the accessibility of working parts. A cooling apparatus has now been fitted behind the bonnet and in front of the dashboard. It consists of two tanks connected by a double row of vertical radiators, a free space being left between them and the dashboard. The shape of the bonnet has been designed so as to cover the mechanical parts of it and yet leave the two upper angles of the cooling apparatus open to the air on either side. The bonnet is entirely closed, and the under part of the motor is encased by a metal apron; a thoroughly enclosed chamber is thus formed. In this chamber a fan, which

THE RENAULT CHASSIS, REAR VIEW



THE RENAULT CHASSIS FROM ABOVE

forms part of the fly-wheel, tends to create a vacuum, and the outside air is drawn in and passes through the double row of gilled pipes. The air fills up the free space between the radiators and the dashboard, whence it crosses the radiators a second time, travels through the covered-in chamber, and escapes beneath the car through the leaves of the fan. The speed of the fan being equal to that of the motor, a very great quantity of air is constantly being passed through the radiators; so much that even when the car is standing the water never reaches 100 degrees of heat. In addition, the thermo-syphon system of circulation is adopted. The course of the water is from the cooler to the engine casing, where, as it increases in temperature, it rises to the upper parts of the cylinder heads, and thence passes into a collector. From the collector it rises up towards the upper tank of the cooler, and is there replaced by an equal quantity of cold water coming from the lower tank. As it cools it descends and goes through the two rows of gilled pipes, where it is submitted to the extremely rapid air circulation just described. In this way it gradually descends until it occupies again the lower part of the cooling apparatus, to start anew through the foot of the cylinder casing, and then begin to rise as it becomes heated. On the 14 h.p. car, both the Simms-Bosch magneto and the high-tension ignition are fitted, a switch being conveniently placed, by means of which either can be brought into use.

The transmission on the Renault cars is through a friction clutch acting on a cone inside the fly-wheel. Spring pallets are inserted under the friction leather, and the thrust on each side is taken up by ball bearings. Close behind the clutch is the change-speed gear, which gives three forward speeds and one reverse. The gear is of the sliding-spur type, but embodies many details of great originality. The spur wheels on the second-motion shaft are mounted eccentrically on the gear-box and are drawn in or out of mesh by means of a toothed rack which causes another spur-wheel to rotate the shaft on which they revolve. The mechanism for changing the gear automatically draws them out of mesh before the sliding wheels on the main shaft are moved to a new position, and then brings them back again into engagement with the required wheel. The result is a very smooth change, and the missing of a gear

by an inexpert operator is almost impossible. From the gear-box the drive is by a universally-jointed shaft to the differential on the rear axle; and on the top speed the drive is direct, the second-motion shaft then lying idle. This principle of transmission was originated in the Renault cars, and has been very largely copied.

The usual brakes, of the expanding type, are provided, the pedal brake acting direct upon the driving shaft. The Renault chassis, unlike that of most other cars of equal power, is constructed of seamless tubing of large diameter fitted with two tie-rods to prevent deflection. No bolts or rivets are used, but all joints are brazed, the whole being thus formed into one solid frame. The motor itself is mounted on a special small frame of tubing which is placed within the main chassis.

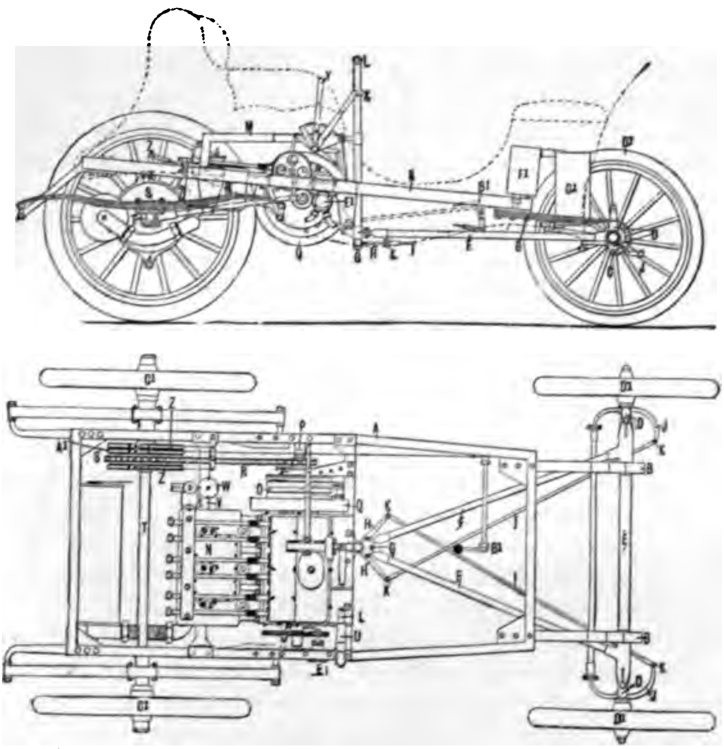
THE DURYEA CAR

It will be seen from the illustrations that the "Duryea Power Carriages," as the motor-cars constructed by the Duryea Company are called, are entirely different in design from any other motor-car. A great deal of ingenuity has been brought to bear on their construction, and no small effort has been directed to produce in them vehicles built on sound scientific lines with regard to the work which they have to do.

The illustration of the complete vehicle shows how successful the designer of these carriages has been in banishing from them all external evidences of their motor machinery; in fact, there is something so mysterious about these cars that the novice would have some difficulty in guessing the position and nature of the engine employed. The correct disposition of weight has been carefully studied; it is placed near the driving wheels, which carry the main load of the vehicle, and close to its work; and in these particulars it differs widely from the ordinary motor-car, in which the engine is placed at the farthest possible distance from its work. The loss of power in transmission, which is a serious mechanical defect in most motor-cars, is reduced to a minimum by the avoidance of the ordinary wheel gearing and intermediate shafts and bearings, the driving of the rear wheels being direct through a powerful chain and live axle. Great care has also been displayed in the steering arrangements,

15-H.P. DURYEA POWER CARRIAGE

which again are quite different from those in any other system. The inclination of the steering centres results in the absorption of all road shocks (which tend to deflect the wheel) at the tyre, and thus relieves the steering connections from all compres-



PLAN AND ELEVATION OF DURYEA CHASSIS

A—Seat Frame.
BB—Springs.
C—Brackets.
DD—Head Lugs.
E—Axle.
FF—Tubular Supports to Axle.
G—Steering Post.
HH—Arms on Steering Post.
II—Steering Rods.
JJ—Steering Arms.
K—Steering Connections.
L—Tiller.
M—Seat Frame.
N—Engine.
O—Power Drum.
P—Bearing for Power Drum.
Q—Fly-wheel.
R—Chain.
S—Differential.
T—Back Axle.
U—Twisting Grip on Steering Handle.
V—Throttle Lever.
W—Carburettor.
X—Clutch Handle.
Y—Reversing Handle.
Z—Brakes.

A^1—Differential Brake.
B^1—Differential Brake Lever.
C^1—Driving Wheels.
D^1—Steering Wheels.
E^1—Gear-driven Pump.
F^1—Water Tank.
G^1—Radiator.

sional strains. This prevents any tendency to reverse the steering, and does away with the necessity for the use of heavy worm gearing. The steering post, being situated in the middle of the car, and the steering tiller available on either side, it is possible for the driver to sit either on the right-hand or left-hand side of the car, although I doubt whether there is any great practical advantage in this. The control is extremely simple and ingenious, the engine being so elastic that the car can be almost entirely driven on the top speed (a direct drive); and the throttling of the engine effected by a slight wrist movement of the twisting grip on the tiller. Gear changing is only necessary for the surmounting of exceptionally steep hills or for reversing; and this is effected by the use of epicyclic gear which is always in mesh, the gearing simply coming into action when required from a state of inactivity.

The engine itself is a horizontal three-cylinder motor, giving either 12 h.p. or 15 h.p., according to the speed at which it is run. The bore and stroke are alike, viz. 4½ inches, the 12 h.p. giving its power at 600 revolutions, and the 15 h.p. engine at 750 revolutions. The cranks are set at an angle of 120 degrees, and the crank-axle is set slightly in advance of the cylinder axis, the purpose being to reduce the angularity of the thrust, and to get an almost direct impulse on the driving stroke. The three cylinders, with their cylinder heads and water-jacket, are cast in one piece without any joints, and are bolted down to a strong aluminium crank case. This has a removable cover secured by bolts, so that, should it be required to take out the pistons, the removal of eight nuts allows the cover, with all the valve gear of the engine undisturbed, to be bodily removed and easily replaced. Both inlet and exhaust valves are placed horizontally in the cylinder head, the inlet valves opening into a single inlet pipe which crosses the top of the engine, and the exhaust valves opening into another pipe which crosses the bottom of the engine, receiving a lead from each cylinder. The valve seats, which are entirely surrounded by water-jackets, are detachable with the valves; the removal of one nut and the bolt of the tappet rod allows the seat to be withdrawn with its valve and spring in position. All six valves are interchangeable and mechanically operated by rods worked from a cam shaft which is geared at half-time from the crank-axle. The removal of an

inspection cover exposes all six to view at the same time. The carburettor is of the float chamber and spray type, the mixing chamber containing a piston, the suction of which, by the inspiration of the engine, not only regulates the amount of mixture passed to the feed pipe, but also automatically increases or decreases the area of the air passage past the jet, and so secures a mixture properly proportional at all times to the needs of the engine and securing absolutely perfect combustion at all speeds. The feed pipe is throttled by a barrel valve and regulates the supply to the engine with the greatest nicety.

The ignition is by the Duryea-Dawson high-tension magneto, driven by friction off the half-time shaft. The current generated in the magneto is passed through a coil, and supplied to the engine through ordinary sparking plugs. However slowly the magneto may be turned, a firing spark is always produced; and the sparking is automatically governed—that is to say, it is advanced and retarded, as the speed of the engine rises and falls, without any action on the part of the driver.

The Duryea cars are of American design, and were, until 1904, made only in America. Now, however, they are built throughout in England at the new works of the Duryea Company at Coventry, the design having been entirely remodelled to meet European requirements. Those who attended the Irish trials at Dublin and Castlewellan in 1903 will remember the successful performance of a 10 h.p. Duryea, which defeated cars of all powers up to 30 h.p., and made better time than half of the cars costing over £1,000. This car covered the flying kilometre in Phœnix Park at a speed of over forty-four miles per hour, and in the hill-climbing contests at Castlewellan for the Henry Edmonds Trophy, which was run over a gradient of 1 in 9, not only finished first in its class, but came within a few seconds of the times made by the 30 h.p. racing cars in the light racing section. It was the only car which went over this steep hill on the top speed without changing gear. These performances cannot but be regarded as remarkable in a car designed and constructed solely for simplicity and comfort.

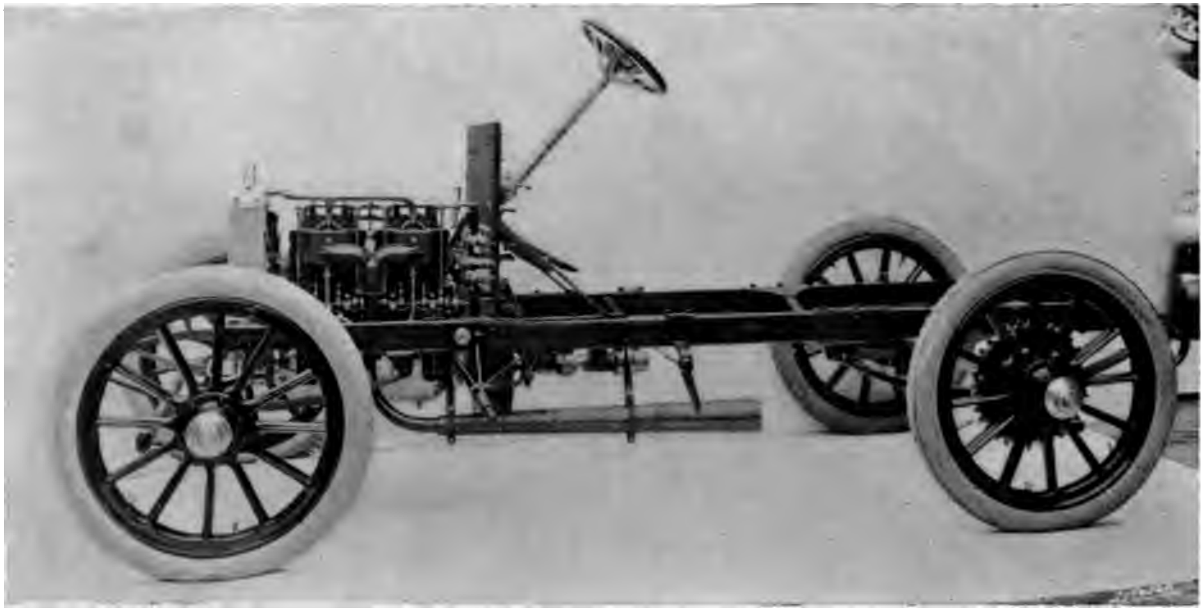
THE HUTTON CAR

The Hutton car, which is constructed in accordance with a number of patents granted to Mr. T. W. Barber, M.I.M.E., has been designed with a view to provide simpler methods of control for the mechanism and less expenditure of physical effort on the part of the driver, and is remarkable for the ingenuity and originality displayed in the effort to secure these results. Unlike the Crossley, it is interesting chiefly on account of this quality of originality, and therefore deserves a somewhat full description. The use of hydraulics in the control of the Hutton car is an entirely new departure, the aim being to abolish the physical strain incidental to the driving of an ordinary high-powered car, so that a person deficient in physical resource may vary the speed of the car, and apply the brakes with little more than the movement of a finger.

The concentration of all the means of control on the steering wheel, which has already been attempted to some extent in other cars, is in this car made a central feature. So far as general construction is concerned, standard lines are followed. The materials used are claimed to be the very finest material obtainable in Great Britain, and the methods of construction are in accordance with the very latest mechanical knowledge.

Fig. 1 shows the general arrangement of the chassis of the Hutton car. It is constructed of nickel steel members, hydraulically pressed to shape and riveted together at the cross junctions with gusset-plates. The springs for the steering axle are provided with elastic dumb irons, which aid considerably in the light running of the car. Cross members are placed where the twisting strains, due to the attachments of the springs, are transmitted to the frame; and this provision enables the frame to be constructed to a very light section, and at the same time considerably increases its rigidity. The general arrangement of the mechanism of the car may also be gathered from this illustration.

Fig. 2 shows a side elevation of the 20 h.p. Standard Hutton Engine. This has four cylinders, cast in pairs; mechanically operated inlet valves, which are placed on the top of the cylinder, and exhaust valves placed in the usual position at the



CHASSIS OF 20-H.P. HUTTON CAR

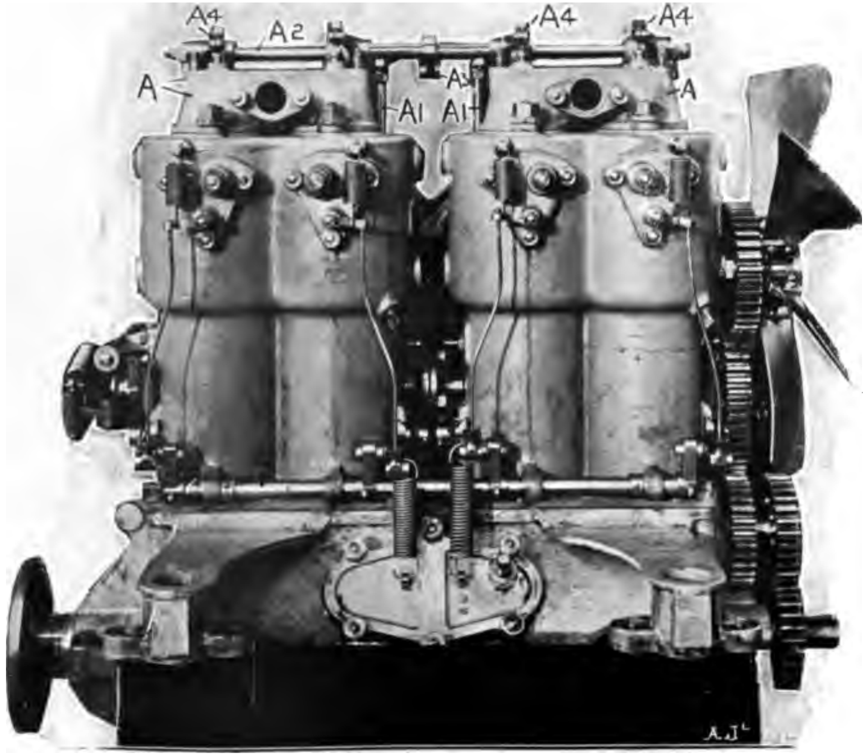


FIG. 2

VIEW OF 20-H.P. HUTTON ENGINE FROM THE RIGHT

SHOWING THE LOW-TENSION IGNITERS AND THE "TIMING" MECHANISM

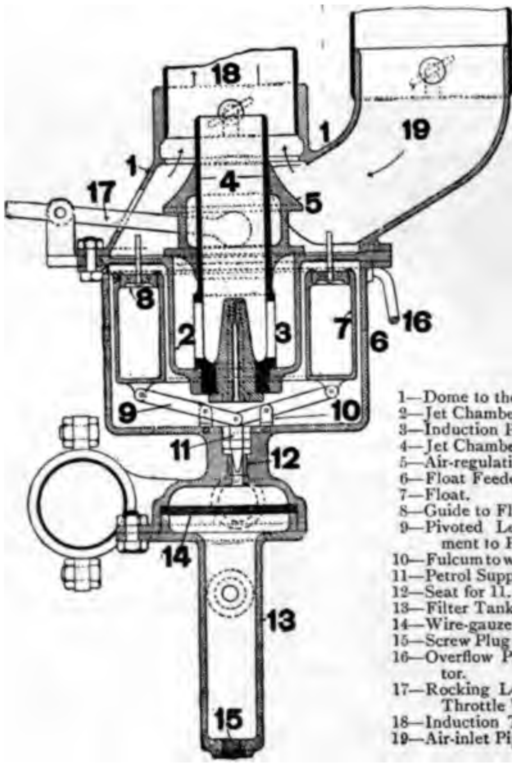
side. The ignition is low tension, and the current is obtained from a magneto. All the movements for the valves and sparking are obtained from one cam shaft, at one end of which the governor is placed, and at the other end gear wheels for obtaining motion from the crank shaft, and also for conveying movement to the gear-driven fan. The position of the inlet valves is indicated at A 4, the exhaust valves at A 5, and the sparking mechanism at B and B 1.

The inlet valves are provided with a variable lift adjustment by means of eccentrics operated from a rocking arm (A 3) on a shaft (A 2). Means are also provided to advance and retard the time of sparking. The fan is shown at G, and the governor at H. The engine and its entire accessory mechanism are carried elastically on the frame of the car by springs which fit into sockets K. By this means the engine is freed from the stresses due to distortion of the frame of the car, and the necessity for a flexible connection between the clutch and gear-box is eliminated.

Fig. 3 shows a sectional elevation of the carburettor. This carburettor is controlled direct from the governor in such a manner that the richness of the explosive mixture is varied automatically according to the speed of the engine and the power required. This is accomplished in the following manner: The body of the carburettor (6) contains an annular float (7) surrounding the jet, which is in the centre of an induction tube (4). This induction tube, which is perforated in the end adjacent to the jet (3), projects into the main induction pipe (18) of the engine. Sliding on the induction tube is a throttle-collar (5) operated by means of a rocking lever (17), which is coupled to the governor. As shown in the drawing, this collar has shut off all access to the induction tube orifices (3), at the same time leaving a full passage for air up the main induction pipe; and this is the position which the collar would assume if the engine tended to race or was set by hand to run at the minimum speed.

When the engine is started, the governor raises the collar to its highest position, and it will then prevent air passing direct into the main induction pipe. All the air will then pass through the induction tube orifices, and thus supply the engine with a rich explosive mixture for starting. As the engine speed

increases, the governor lowers the collar; air is then admitted direct into the main induction pipe, thus gradually reducing the strength of the mixture until the correct proportions of petrol and air are obtained for the speed and power required of the engine. Acceleration or retardation of the engine is obtained in the usual way by the interposition of a spring actuated from



1—Dome to the Carburettor.
2—Jet Chamber.
3—Induction Ports.
4—Jet Chamber.
5—Air-regulating Valve.
6—Float Feeder Chamber.
7—Float.
8—Guide to Float.
9—Pivoted Lever giving movement to Petrol Feed Valve.
10—Fulcum to which 9 is connected.
11—Petrol Supply Valve.
12—Seat for 11.
13—Filter Tank to Carburettor.
14—Wire-gauze Strainer.
15—Screw Plug in bottom of Filter.
16—Overflow Pipe from Carburettor.
17—Rocking Lever operating the Throttle Valve 5.
18—Induction Tube.
19—Air-inlet Pipe.

FIG. 3. SECTIONAL ELEVATION OF THE HUTTON CARBURETTOR

the dashboard and operating against the governor. Below the carburettor a water-separator (13) is attached. The petrol is admitted near the top of this separator, and passes upward through the gauze filter (14) into the carburettor; particles of water and dirt are intercepted by this gauze and gravitate to the bottom of the separator, from which they can be drawn off through the tap at any convenient time. Hot air is supplied to the carburettor through the orifice (19); this is obtained in

FIG. 4
VIEW OF THE HUTTON RADIATOR

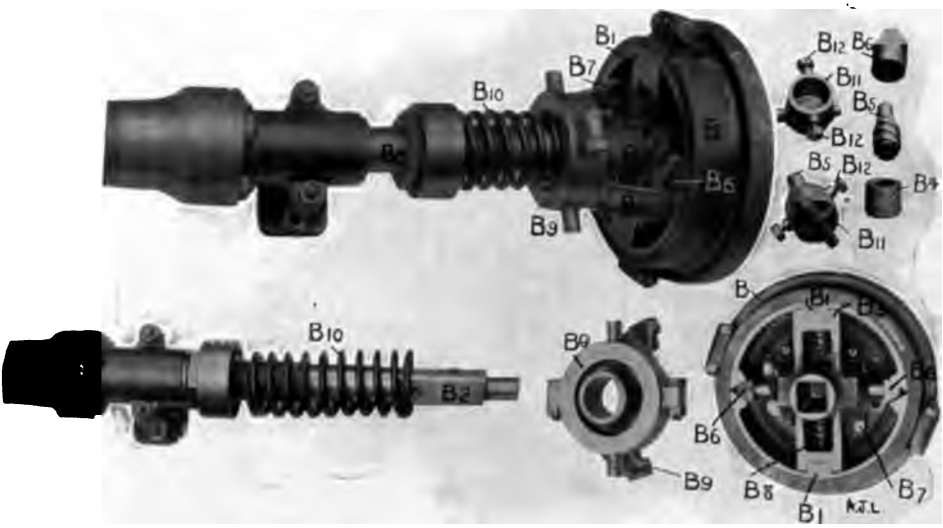


FIG. 5
DETAILS OF HUTTON CLUTCH

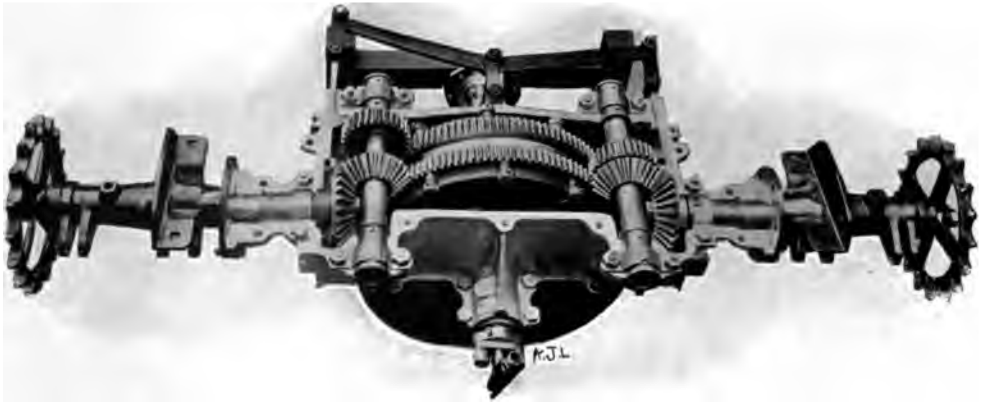


FIG. 6

VIEW OF THE BARBER VARIABLE SPEED GEAR, FOR THE 20-H.P. HUTTON CAR

the usual manner by surrounding a portion of the exhaust pipe of the engine with a tube leading to the carburettor.

Fig. 4 shows the radiator. The chief feature of this is the use of the bent tube, which gives the radiator an efficiency equal to nearly three times that which it would have if straight tubes were used. This form of tube affords a free passage to the circulation of the water, and is not at all liable to be choked up with sediment. It is constructed entirely of aluminium. The end receivers are aluminium castings, and the tubes are drawn aluminium; and the weight of the radiator is said to be less than half that of any other radiator of equal efficiency.

The metal clutch (Fig. 5), which transmits the power from the engine to the gear shaft, is constructed with a cast-iron ring (B) attached to the fly-wheel, and is provided with grooves similar to grooves turned in the split rings (B), which form the expanding portion of the clutch. These rings are operated by means of wedges (B 6), which are advanced and retreated by levers (B 7) and screws (B 5), the latter working in spherical nuts (B 4). These levers are moved backwards and forwards by means of a sleeve (B 9) on the shaft, operated in the usual manner with a forked arm. The spring (B 10) is adjustable, and the clutch is controlled in the usual way by a foot lever. The adjustment for wear is very easily and quickly accomplished by means of two set screws (B 12), which project into cavities, a number of which are formed in the sides of the spherical nuts (B 4). All that is necessary to take up the wear of the clutch is to slacken back these set screws and rotate the nuts until the next cavities register with the set screws, which are then tightened up again. An annular chamber is provided in the outer ring to carry a quantity of oil, which is supplied constantly to the clutch; and the effect of the grooves is to keep the whole of the working surfaces of the clutch constantly lubricated. This causes the clutch to have a very sweet action, and relieves the car from shock, even if the clutch be let in suddenly, as may be sometimes done.

A very important feature of the Hutton car is the infinitely variable speed gear (Fig. 6), by means of which all the disadvantages of the ordinary fixed gears are eliminated. Figs. 7 and 9 show a section through the shaft, eccentric sheave, and strap. A cross section of these parts is shown in Fig. 8, Nos.

(13), (16), and (18), surrounded by the rotating portions (1), (3), and (4) of the gear. In these illustrations the sheave is shown at its maximum stroke. The variation in stroke of the eccentric is obtained by *hydraulic pressure.* The pressure fluid is admitted through the centre of the shaft under the ram (17), which forces the sheave and strap outwards according to the quantity of fluid admitted to the cylinder.

The cylinder is formed of the body of the shaft (21)—is, in fact, bored out of the cross-head, which rotates the sheave and

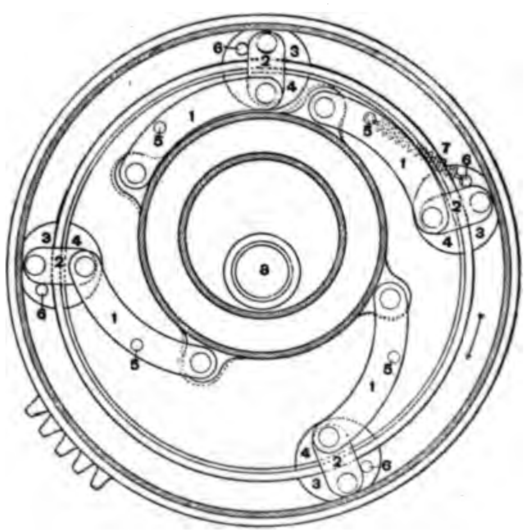


FIG. 7. ELEVATION OF THE HUTTON GEAR

1 1 1 1—Side Links for Toggles.
2 2 2 2—Toggle Links.
3 3 3 3—Outer Toggles.
4 4 4 4—Inner Toggles.
5 and 6 repeated—Pins for Springs as shown by 7.
7—Spiral Spring to Toggles.
8—Shaft.

upon which the sheave slides. In Fig. 7 the eccentric strap is shown with links (1) attached to the lugs. The other ends of the links are attached to toggles (2), which form a connection between shoes (3) and (4) operating on either side of rings provided on the rotating portion of the gear. The effect of this toggle movement is that a species of free-wheel construction is obtained, so that when the links move in one direction, the shoes are caused to grip the rings on the periphery of the gear and the whole rotates; while when they move in

FIG. 11
FRONT VIEW OF THE 20-H.P. HUTTON CHASSIS

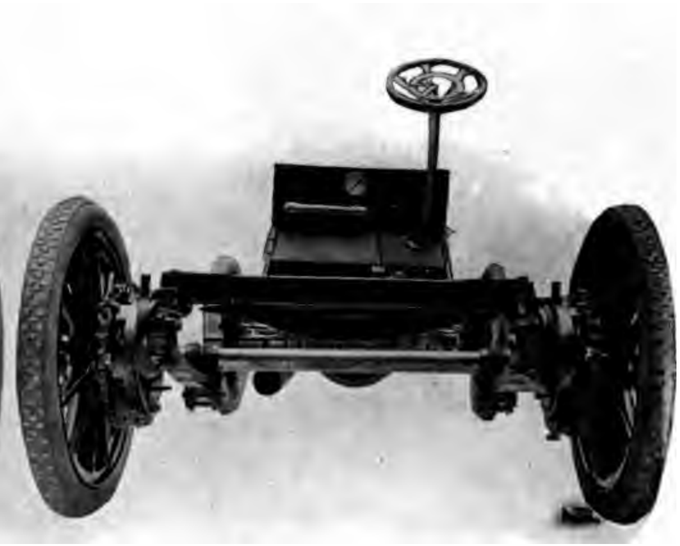


FIG. 12
REAR VIEW OF THE 20-H.P. HUTTON CHASSIS

FIG. 13

CENTRAL PORTION OF THE HUTTON CHASSIS

SHOWING THE HAND LEVERS ABOVE THE STEERING WHEEL, THE HYDRAULIC ACCUMULATOR ON THE DASH, AND THE EXPANDING MAIN CLUTCH

the other direction the shoes are disengaged and slide back freely on the rings. When the eccentric is quite central, no movement is conveyed to the strap, but as soon as a small amount of eccentricity is given to the sheave, the strap gyrates and each of the lugs on the strap describes a circular movement, corresponding with that of the eccentricity of the sheave.

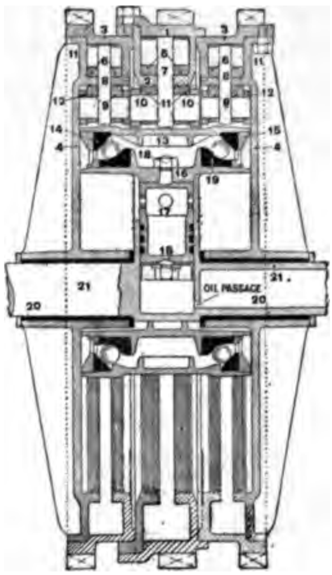


FIG. 8. SECTION OF THE HUTTON GEAR.

1 2—Case for Middle Toggles.
3 4—Case for Side Toggles.
5—Middle Toggles.
6 6—Outside Toggles.
7—Middle Toggle Link.
8 8—Side Toggle Links.
9 9—Inside Toggles.
10 10—Middle Inside Toggles.
11 11—Middle Inside Toggle Links.
12 12—Outside Toggle Links.
13—Eccentric Outer Case.
14—Outer Ring for Ball Race.
15—Locking Ring for Outer Ball Race
16—Eccentric.
17—Piston.
18—Nuts for Piston.
19—Inner Ball Race.
20 20—Shaft Bearing.
21—Shaft.

The greater the eccentricity of the sheave the greater the circular movement of the lugs, and consequently the more reciprocating movement is communicated to the links and through them to the periphery of the gear. The provision of large ball bearings between the sheave and the strap at (14) and (19), Fig. 9, reduces the friction in this gear to a minimum, and

the provision of large wearing surface on the shoes (3) and (4) and large-diameter pins reduces the wear and tear to negligible amount.

The control of the gear is effected through a small lever on the steering wheel, which operates inlet and exhaust valves. The inlet valve is supplied with oil from an accumulator on the dashboard, in such a manner that the opening of the valve admits pressure fluid to the ram (17) in the gear, and thus increases the movement of the gear and the speed of the car. The opening of the exhaust valve allows the pressure fluid to escape, thus decreasing the movement of the gear, and reducing the speed of the car. It will, of course, be under-

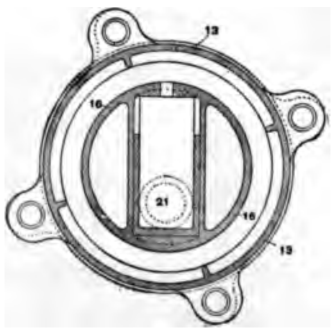


FIG. 9

This drawing shows the detail of the Ram 17 and the Eccentric 16 in cross section. It is a transverse section through the Ram and Eccentric.

stood that when the eccentric is at the centre the gear is motionless and may be used as a clutch; and it is therefore possible to do away with the clutch on a car provided with this gear. This will eventually be done in the Hutton car, but in view of the fact that so many drivers are accustomed to control their cars largely by means of the clutch, it is thought desirable in the first instance to retain the clutch, and only to abolish it when the newer and simpler method of control is becoming more familiar. This gear also takes the place of the differential, and a very simple reverse is obtained in practice without the addition of any further mechanism, save the reversing lever, which is clearly shown in Fig. 6. It may therefore be said that in this gear the motorist has clutch, differential, reverse, and

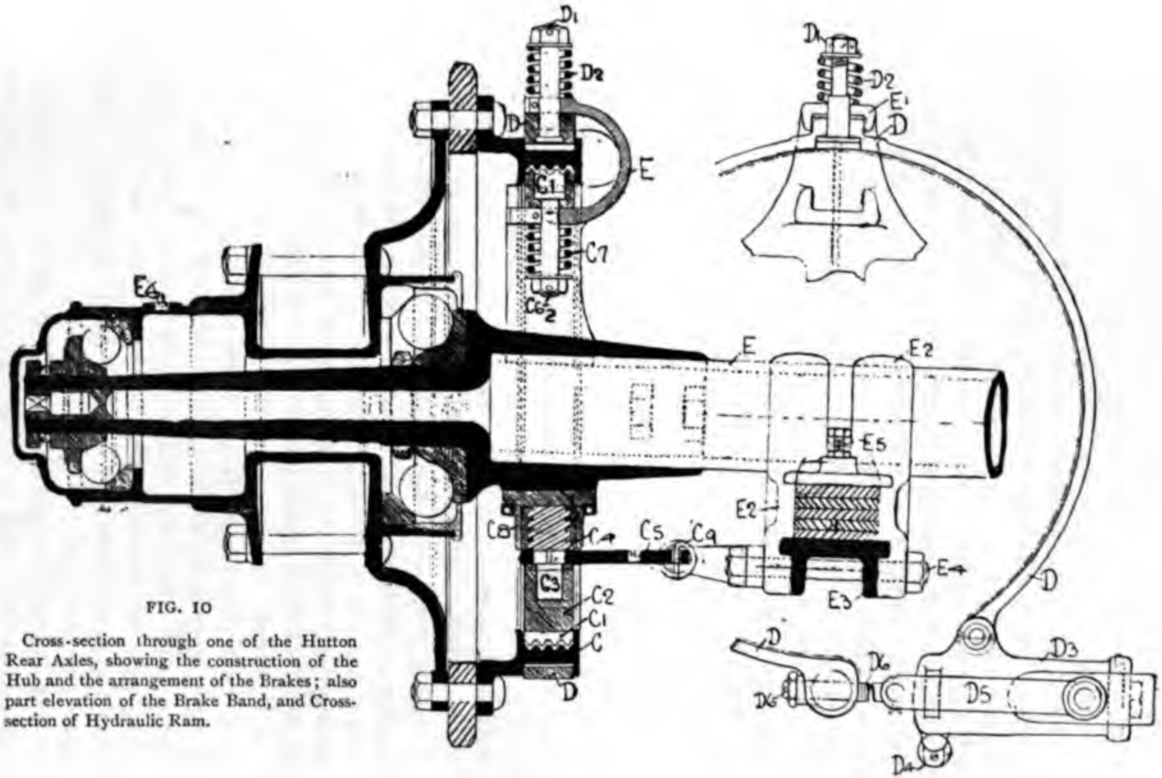


FIG. 10

Cross-section through one of the Hutton Rear Axles, showing the construction of the Hub and the arrangement of the Brakes; also part elevation of the Brake Band, and Cross-section of Hydraulic Ram.

all speeds in both directions, in one compact combination. The whole mechanism operates in an enclosed gear-case (the top half has been removed in Fig. 6), which is kept half full of lubricant.

Fig. 10 is a sectional elevation, through the end of the axle (E) and the hub of the driving wheel. A section is also shown through the external and internal brakes (D) and (C 1), which are coupled direct to a flange on the hub of the wheel, to which also the driving sprocket is attached; the chief feature of this hub is the large diameter of the balls adopted for the anti-friction bearings. The axle is a nickel steel tube, and the axle-end, carrying the ball races, is a nickel steel drop forging. The method of attaching the springs to the axle is shown at E 2. The keeper-plate (E 3) slides in grooves provided in the axle-strap (E 2), and transmits the whole of the stresses direct to the axle. The bolts (E 4) have only to retain this keeper in position.

The portion of the cross section showing the internal and external brake in this view is chiefly interesting because it shows the screws (C 3), lever (C 5), and nut (C 4), and a section through the wedge (C 2), by which means the mechanical brake-ring is expanded. This arrangement is similar to that already described in the clutch. Details of the external, hydraulically controlled brake are also shown. The hydraulic cylinder (D 3) is shown, attached to the brake-ring (D) with the links (D 5) in position, which transmit the movement of the ram (D 1) to the other portion of the ring, through a universally jointed connection at (D 6). The section given shows clearly the manner in which the admission of oil pressure to the cylinder (D 3) communicates movement to the links, and contracts the brake-ring upon the drum (C). These brakes, both internal and external, are supplied constantly with oil under pressure from the special lubricator which is attached to these cars. Consequently the action of the brake, like that of the clutch, is a sweet and gradual one, and the firing or seizing of the parts need not be feared.

The steering axle head, which is shown in a front view of the chassis (Fig. 11), is of special cast-steel; the swivelling axle is a nickel stee' drop forging, and the hub, as is also the case with the rear wheels, is of cast-steel. The weight of the fore-

end of the car is transmitted to the wheels through a ball race in the head, while at the same time all side stresses, which would be liable to interfere with the perfect movement of this race, are eliminated by means of a central pin, upon which the swivelling axle turns. This ball bearing makes the steering of the car very easy. The central pin is hollow and will contain sufficient lubricant to keep the hub ball races in good condition for many months.

The large size of the balls used, and of the ball races, is a notable feature in the construction of these hubs; and it will also be seen that, although they are very large in diameter, they are light in weight; the construction, in fact, is tubular, similar to that of many other portions of the car.

Figs. 11 and 12 show the general arrangement of the steering apparatus, and give front and rear views of the chassis. The steering screw is carried between ball thrust-bearings, and a spring device is inserted in the horizontal steering arm, which eliminates shock to the steering apparatus, and thus makes it unnecessary to provide complicated devices for the taking up of undue wear of these parts. The ordinary ball and socket universal joint is not used in this car, the designer insisting that it is a dangerous type of construction for so important a part of the car mechanism. The valves for the hydraulic control are manipulated by means of rods attached to the lower end of the tubes of the steering pillar, and are controlled by levers at the top of the steering column. These levers and tubes are shown clearly in Fig. 13. One lever for the carburettor, one for the brake, and one for the variation of speed. The segment over which these levers work is marked clearly BRAKE; on—off; SPEED; increase—decrease; MIXTURE; rich—weak.

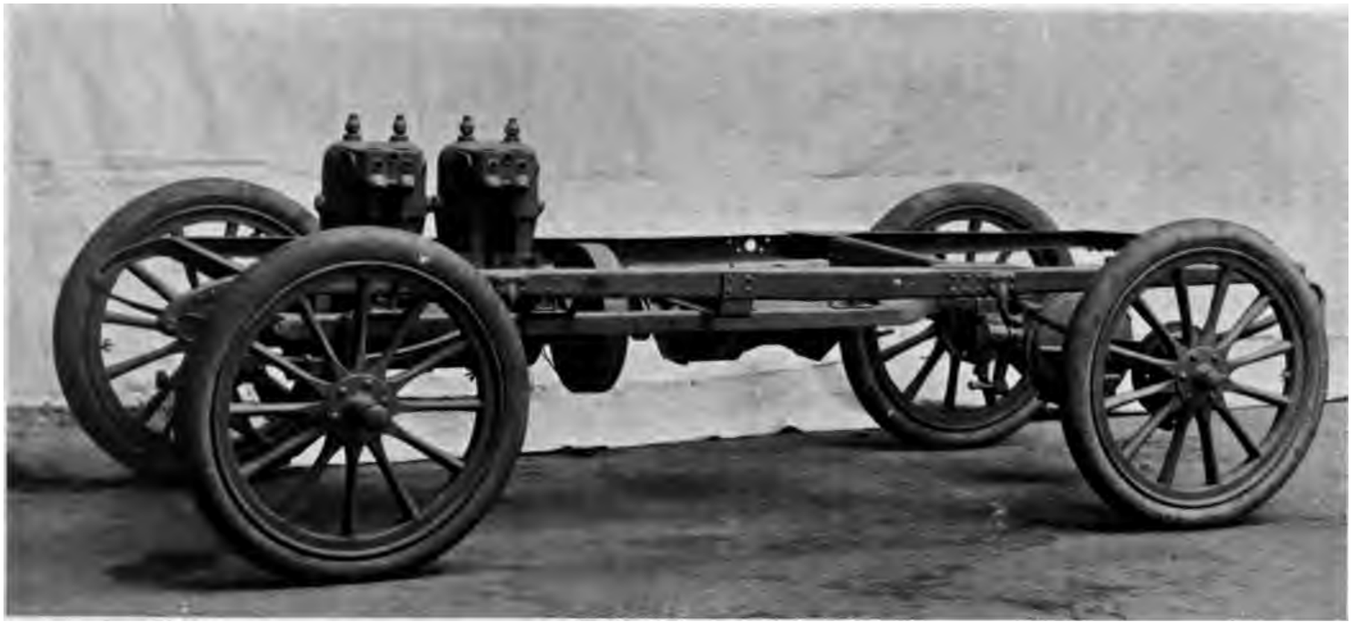
This figure also shows the starting-gear attachment on this car, which is on the near side of the vehicle and just in front of the dashboard. Instead of the usual arrangement placed on the front of the car, underneath the radiator, a side shaft is provided, gearing through bevel wheels, on to a suitable engaging stud in the fly-wheel.

The accumulator, which forms the central feature of the hydraulic control apparatus, is shown on the dashboard with pressure gauge attached. It consists of a chamber in which a spring is confined between two pistons. One end of this

chamber forms a storage for oil, under pressure, which is distributed to these portions of the gear operated by its means, and the other end forms an elastic device for eliminating shock when starting up the speed gear. This end of the chamber, in fact, is placed in series with the cylinder contained in the speed-gear shaft, so that the strap and links are actually operated by an elastic medium, instead of by an incompressible element, such as oil or water under pressure would be without this arrangement. This accumulator is charged constantly by means of a slow-moving pump, which is operated by the second-speed shaft of the motor.

THE THORNYCROFT CAR

Like several other engineering firms of great and honourable reputation, the Thornycrofts have recently undertaken the manufacture of light motor-cars. They have been hitherto identified with the heavy steam vehicles bearing their name which have done so much to convince those whose business employs heavy transport that the motor-car is in the long run by far the cheapest and most efficient means of transport. Now, however, they have added the light passenger car to their list, and although they are, like so many others, as yet dealing with comparatively unfamiliar conditions of weight and strain in such light machinery, their progress so far is an assurance that their cars will before long take a very high place indeed among those manufactured in this country. They have very wisely laid down certain principles in starting—principles which for the sake of the health of the motor industry one could wish had been more universally adopted. Simplicity, fewness of parts, and endurance are the three principal characteristics of the Thornycroft cars. And if one looks in vain in them for those doubtful refinements and complications which, in the hands of any but the most experienced builders, assist in keeping up the prejudice that motor-cars cannot be trusted to run for long without breaking down, ample compensation is provided in the reassuring strength and simplicity of the design. The illustration of the Thornycroft chassis gives a good idea of this simplicity and strength. It will be seen that the vertical forward position is adopted for the engine, which consists of four cylinders cast in



THORNYCROFT 20-H.P. CHASSIS

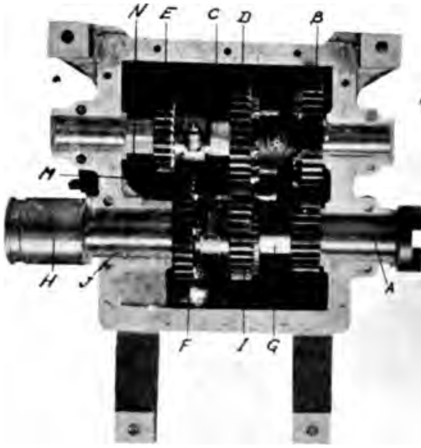


Fig 1

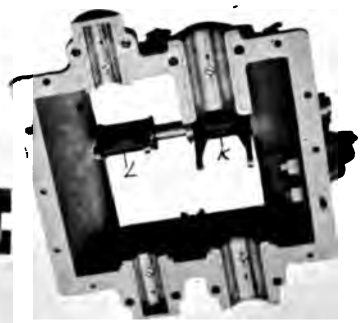


Fig 2

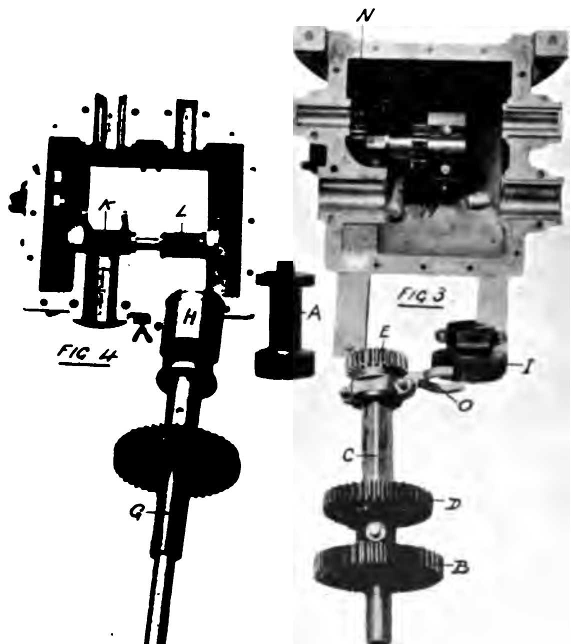


Fig 3

Fig 4

Fig 5

Fig 6

III.

THORNYCROFT CHANGE-SPEED GEAR

20-H.P. THORNEYCROFT CAR

pairs. The drive is through a clutch to a roomy and accessible gear-box, and thence by universally-jointed shafts to a live rear axle, which is driven by bevel gear. A separate under-frame is provided for the engine, and the frame of the car, of the very simplest design, is of stout channel steel strengthened by cross members and stays. The springs are of the semi-elliptic type, and are attached to the axles by strap bolts, and to the under-frame by cast manganese steel scrolls and links. The leading springs are fixed at the forward end and free at the rear end, while the rear springs are free at the front end and attached at the rear ends to the extremities of a cross-spring which is fixed to the rear cross member of the frame. The wheels are of the artillery type, the naves of the leading wheels being of bronze, and those of the driving wheels of stamped steel. The engine is designed to run at a normal speed of 900 revolutions per minute, and is capable of acceleration up to 1,400 revolutions. The water-jacketing of the cylinders extends about half-way down from the firing end, and has been carefully designed to avoid any impediment to the free and natural circulation of the cooling water, which is driven round the cylinders, honeycomb radiator, and tank by an enclosed pump geared to the crank shaft. Each piston is provided with four spring rings ; the connecting-rods are of stamped steel with adjustable big ends. The crank shaft is a single steel piece with a central bearing only between each pair of cylinders. The cranks of each pair of cylinders are set at 180°, which ensures a very good balance. The forward end carries the gear wheel for operating the pump, and is further prolonged to the front of the car to receive the starting handle ; its rear end is coned and keyed to receive the combined fly-wheel and friction clutch. Atmospheric inlet valves are used, and the exhaust valves are operated in the usual way by cams on a half-speed shaft.

The arrangement of the gear-box is very clearly illustrated in the accompanying plate. Fig. 1 shows the lower half of the case with the gears in the second-speed position. Fig. 2 shows the upper half of the case, with the striking levers, by means of which the position of the gear wheels is moved. Fig. 3 shows the lower half of the case with the reverse gear in position, but with the other gear removed ; Fig. 4 another position of Fig. 2, and Figs. 5 and 6 the separate shafts with their gear wheels.

The sleeve A, with a claw clutch and pinion solid with it, is driven through the friction clutch from the engine. In its turn it drives, by means of the wheel B, the second shaft C at a constant reduced speed. The wheels B and D are fixed on the shaft. The wheel E is capable of sliding on the squared part of the shaft C, and can be brought into gear when required with the wheel F, which is fixed to the shaft G. This shaft has at one extremity the universal coupling H, and takes a bearing at one end in the large journal J inside of the sleeve A. The wheel I is free to slide upon the squared part of the shaft G and to engage as shown with the wheel D, or to engage by means of internal clutched teeth with the projecting portion of the wheel on the sleeve A. On the first speed the sliding wheel I is disengaged, and the sliding wheel E is brought into engagement by means of the forked lever L with the wheel F. On the top speed the drive is direct. The wheel I is then moved on its shaft so that the internal teeth engage with the teeth on the wheel fixed to the sleeve A. Under these circumstances the second shaft C revolves idly. Messrs. Thornycroft prefer the simplicity of this method to the use of springs and triggers for throwing the second shaft out of gear. They tell me they find that with their well-cut and thoroughly hardened gear-teeth the second shaft runs noiselessly, and practically without wear. The reverse is obtained by the gearing of the sliding pinion M with the low-speed wheel, the wheels E and N also being in gear. The ignition used is either magneto or the ordinary high-tension coil system ; if a dynamo be employed with the coil, the motor is first started from the battery, which is then cut out and the dynamo switched on as soon as speed has been obtained.

The car shown in the illustration is a standard 20 h.p. car, the only other size made being a 10 h.p. car, the engine of which has two cylinders instead of four.

CHAPTER V

STEAM CARS

The advantages of steam—Has the last word been said?—The sensitive and responsive motor—The American steam car—Its rise and fall—Unwise commercial conduct—Ignorant handling and its results—The American run-about described—The Serpollet-Simplex car—Steam and luxury—The White steam car—A deserved success—The S.M. steam car—The problem for the designers—No glands, no leaks—No petrol, no danger—The importance of being automatic—An ingenious water control—Nothing to wear out—A fine engineering achievement.

BEFORE the invention of the light petrol engine practically the only motive power used for road carriages was, as we have seen, steam; and in spite of the great development and popularity of the petrol engine, the light steam engine has side by side with it been improved and adapted for the purpose of motor-cars. Its popularity, however, has waned in proportion as the popularity of the petrol engine has increased, and to-day the range of choice offered to those who prefer the steam engine to the petrol engine as a motive power for automobiles is restricted to a very few types of car. These may be broadly grouped under three divisions—the Gardner-Serpollet system, which is unlike anything else, and was at the beginning of 1904 practically the only steam system applied to light motor-cars of a large horse-power; the light American car known as the "run-about," the most popular examples of which are the Stanley and Locomobile cars; and a later and more practical development of the light American car in which the steam is condensed over and over again and returned to the water-tank, and where either single-acting or compound engines are used instead of the old double-acting type.

Before discussing these three types in detail, a word or two with regard to steam as applied to motor-cars will not be out of

place. There can be no doubt that the ideal motive power is electricity; but we have not yet reached that point in invention at which the application of electricity is practical for long-distance work. The choice therefore remains between steam and petrol. The advantages of steam are very many, so many, in fact, that not a few engineers believe that the last word about steam, pending the final development of electricity, has by no means yet been said. Steam is simple and silent in its action, and the absence of explosion makes the wear on the motor-car itself much less severe. Moreover, the elasticity of steam gives a range of speeds far greater and more delicate than that afforded by the inelastic explosive engine; and this elasticity does away with one of the most formidable and expensive parts of the petrol car, viz. the elaborate and by no means ideal arrangement of gears by which (since the speed of the engine remains practically constant) the speed of the car is varied. The fact also that in any part of the country someone can be found who understands the steam engine is, in case of break-down, a by no means despicable consideration; for it is most unwise and unsafe to allow local mechanics to tamper with a modern petrol engine. There is also the advantage that, given a satisfactory form of furnace, the steam car is more economical in its working than the petrol car; and the purely sentimental advantage, and perhaps not a very important one, that to some engineers the steam engine will always seem a more human and responsive agent to work with than a petrol engine. Why this should be so I do not know, but it is a fact that cannot be ignored, the sense of which is very deeply implanted in the ordinary man who has ever had to do with machinery.

The disadvantages of the steam car are that three separate pieces of apparatus are essential—the furnace, the boiler, and the engine itself; and this goes some way to minimise the advantage gained by the steam engine in its avoidance of the necessity for complicated gears. Moreover, the necessity of taking in water at comparatively short intervals was, in long-distance motoring, found to be a nuisance. A further disadvantage inseparable from steam engines is the necessity of having a lighted fire carried about with the vehicle itself. The smallness of the space available and the great pressure of steam employed in these machines make it necessary that the furnace should be

capable of developing great heat, and this is only possible either with petrol, the burning of which involves some danger, or of paraffin oil, which has hitherto not always been satisfactory. Moreover, the space occupied by the boiler and furnace, as well as by the large water and petrol tanks which it was necessary to carry, robbed the carriages of that roominess and extent of accommodation which are such strong features of the petrol car.

A few years ago the light American steam car had a great vogue in England. By far the commonest type in use was that manufactured and sold by the Locomobile Company—a little vehicle representing a great deal of ingenuity in design and construction, and also illustrating that remarkable strength which the American engineers, above all others, seem to have achieved in the construction of very light machinery. But these little cars, which were sold in enormous quantities, were often imperfectly equipped by the makers, and such things as water- and air-pumps, engine covers, condensers, additional brakes, super-heaters, forced draught and automatic lubricators, which should have been regarded as part of the machine, were sold as extras, and, of course, in many cases not sold at all; so that too often the novice went out with a machine consisting of a body, four wheels, a boiler, and an engine, and very little else. Naturally, these engines gave a great deal of trouble and fell into disrepute, not so much because of their own defects as the defects of the people who drove them and the neglect to equip them fully on the part of those who sold them. The condition of the light steam car was indeed broadly this. For the sum of £200 or £300 the purchaser was able to get a light car which could run in fine weather and on fine roads with great ease and smoothness for a short time, but which, after a little while, would begin to show signs of wear and a tendency to break down, chiefly owing to lightness of construction and a somewhat haphazard trust in the operator's knowledge and experience. The inexpert owner of such a car, wishing to get the greatest possible amount of efficiency out of it, found himself virtually prevented from taking it out except in fine weather when the roads were dry, as the splashing of mud into the bearings of the small engine rapidly produced symptoms of an approaching end to that engine's efficiency. He found himself, moreover,

pinned down to routes where he could take up clean water within twenty-mile stages, and he was also under the necessity of replenishing the petrol tanks at intervals of not less than forty miles.

This, of course, although it provided the possibility of a very pleasant kind of country jaunt or journey, could hardly be described as motoring in the serious sense in which that term is nowadays used. To enable the light steam car to hold its own with its great rival, it became at once necessary to extend its sphere of "non-stop" activity, and so to strengthen and protect its working parts that it should be as independent of weather and the condition of the roads as it is possible for a pleasure vehicle to be. An effort was therefore made to improve the light steam car and bring it up to the high standard demanded by comparison with the petrol cars; and so far as cars running in England are concerned, the credit for this improvement is mainly due to the builders of the "White" car. By grappling with the problems of lubrication, condensation, and, above all, of a boiler which should be practically automatic in its motion, they achieved much; and by care in construction, which had not been hitherto shown, their improvements went far to remove many disabilities under which steam cars had laboured. In addition to this they have now brought out a steam car of a type which, I believe, will have a great vogue in the future, viz. a steam tonneau car with the engine in front under a bonnet in such a position that all taps and levers can be brought immediately in front of the driver on a control board, thus doing away with the awkward fumbling under the seat made necessary by the centrally placed engine. They have now been followed by the constructors of the S.M. car, who are bringing out a new car with a four-cylinder, single-acting engine of great power in proportion to its bulk, equipped with a flash generator and control that are entirely new in principle, perfectly automatic, and almost indestructible.

The alternative to the light car in England has practically been found in the use of the Gardner-Serpollet car or the Miesse car. Both of these, however, are cars of very elaborate and fine design. They are somewhat expensive to run and to take care of; but provided it is properly taken care of, there is probably no more luxurious touring car on the roads to-day

than the Gardner-Serpollet. The ingenuity of M. Serpollet's mechanism was the feature of the early days of the motor movement, and it remains one of the triumphs of motor-car engineering to-day.

The older type of American run-about may be briefly described as a tubular steel framework mounted on wire wheels and carrying a body consisting of a seat for two people, a large tank for water, a boiler, furnace, and engine, as well as fuel and air tanks—the engine a small double-acting, high-pressure steam engine, with two cylinders of about 3½ inches by 2½ inches dimensions. These engines were coupled by connecting-rods to a crank shaft, on which was a sprocket wheel coupled by means of a chain to a larger sprocket wheel on the rear axle. The usual type of boiler was a very small and highly efficient fire-tube boiler some fourteen inches in diameter, and containing about 300 copper tubes. Undoubtedly in careless hands these boilers may be a great nuisance, and even a considerable danger, but I have run one for many thousands of miles without ever having any trouble. They develop a very large quantity of steam, and although of course the water level and the steam pressure require constant watching, I have found this in my own case to become automatic, and a by no means unpleasant occupation in driving. The exhaust steam in cars of this type is led through a small silencer into the exhaust pipe or into a condenser, out of which it drips on to the road in the form of water. Such cars could carry fuel for about fifty miles and water for about thirty, and for the purpose of running about parks or taking short country trips in fine weather they are very pleasant. They are easy and silent running, and the very considerable power which they develop in hill-climbing wins for them many friends. The indicated horse-power of such an engine as I have described is about 5½, but it is, of course, capable of developing much more, and such a car would leave many a 15 or 20 h.p. petrol car behind in going up a short steep hill. The burning of vaporised petrol, however, is always an anxious and a dangerous business, and many an owner of these light American steam cars has had the mortification of watching his smart little vehicle wrapped in a column of flame twenty feet high. For running in a high wind a forced draught is moreover absolutely necessary in cars of this type; otherwise it is impossible to make steam. But when all

the conditions are favourable and when the car is properly equipped these little engines are very pleasant indeed to drive for anyone who has a taste and liking for machinery. They are so fast and responsive and they are such good hill-climbers, they contain the whole apparatus of a high-pressure steam engine within such small and compact bounds, that many a day can be happily spent on them touring along country roads in the summer time. They are now, however, being replaced by more powerful, better designed, more simple and efficient steam cars, which, if they do not furnish their driver with quite so much experience and roadside occupation, at any rate carry him at higher speeds with less trouble and greater certainty.

At the same time it must not be forgotten that the locomobile steam cars probably did more than those of any other make to popularise motoring in this country, and that, used as they were by the most influential of converts to the new pastime, they introduced numberless people to the pleasures of motoring, and were, in a sense, the pioneers of the larger and faster cars. I am inclined, I repeat, to think that the loss of reputation which they undoubtedly suffered was due, not so much to inherent defects of the cars themselves, as to unwise methods adopted in selling them, and in their misuse by private owners. After the South African war the Locomobile cars had a great vogue amongst military officers, who, as a class, abused them ruthlessly and foolishly, treating them much as a child treats a fascinating toy which will not yield its fullest satisfaction to him until he has experienced the sensation of destroying it. It is a curious fact that the Locomobile steam cars were never so well made or so completely and efficiently fitted as when their reputation was, in this country, at its worst. I speak with knowledge, having driven many cars, both steam and petrol; and although I am under no delusions as to what a locomobile will *not* do, and as to its comparative uselessness for touring purposes, I have found it at all times a trustworthy and pleasant little carriage. I may have been lucky, or careful, or both; but during the thousands of miles that it has carried me on English roads I do not know how many dozen of petrol cars I have seen disabled by the wayside, but I have never had a breakdown on the road, and the car has never failed to bring me to my

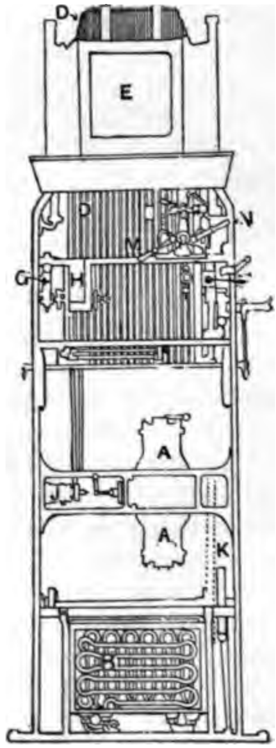
THE SERPOLLET-SIMPLEX CAR

destination faithfully and—except in one case when I had to run seven miles on a torn tyre—punctually; and I believe that there are many who have had similar experiences. The modern Locomobile steam cars are excellent cars, as are also the Stanley steam cars, a similar type; but there has lately been a decided public movement in favour of more automatic mechanism than that necessitated by tubular boilers and double-acting burners; and it is to this that I attribute the temporary eclipse of the light steam car. But that it is only a temporary eclipse I am absolutely certain: the success of the "White" car proves that. The early steam cars required a very sensitive ear and touch for their proper manipulation, and these are qualities in which the ordinary driver of a motor-car has hitherto been conspicuously lacking.

THE SERPOLLET-SIMPLEX CAR

The cars built under M. Serpollet's system represent the acme of luxury and ingenuity in steam motor-cars. Their beautiful workmanship, their powerful and trustworthy engines, and their roomy and comfortable carriage work, have caused them to be extensively used by automobilists who are sensible enough to wish to tour comfortably, and rich enough to be able to choose an ideal means of indulging their taste. A very expert mechanic indeed has hitherto been indispensable to the owner of a Gardner-Serpollet car, as both the delicacy of its mechanism and the nicety of knowledge and experience required for driving it properly would have made too heavy demands on the time and attention of the amateur. M. Serpollet, however, has never stood still and has always improved his cars; and in the 1904 cars a great advance has been made in the direction of rendering them simpler in construction and more automatic in control, so that the disadvantages arising from inexpert driving have been reduced to a minimum. The extremely complex but beautifully designed mechanism for working the pump supply of water and fuel has been abolished, and replaced by a much simpler contrivance which is automatic. The general construction of the Serpollet-Simplex car, as the new pattern is called, will be seen from the illustration. A long steel frame is mounted in the ordinary way, and carries a large water-tank

under a bonnet such as covers the engines of a petrol car. In front of this a radiator is fixed, and below the car a set of condenser tubes for the purpose of completing the condensation of steam and returning it to the water-tank. Behind the back seat is fixed the generator, which consists of a series of coils of nickel steel tube of a C-shaped section placed within a metal



A A—Motor.
B—Steam Generator.
C—Hand Pump.
D D—Condenser Tube.
E—Water Tank.
F—Oil and Fuel Distributor.
G—Water Pump to Generator.
H—Automatic Lubricator.
J—Separator.
K—Driving Chain.
M—Forward and Reverse Lever.
N—Lever controlling Distribution Valves.

SKETCH-PLAN OF THE SERPOLLET-SIMPLEX CHASSIS

skin lagged with asbestos. These are kept at a high degree of heat by the furnace, which is situated directly beneath them, and on the pumping of water into the tubes it is instantly flashed into steam, which, however, has to traverse the whole length of the heated tubes before it enters the engine in a highly dry and superheated condition. The engine consists of four single-acting cylinders placed horizontally beneath the car a little forward of the rear wheels; and they are placed in pairs,

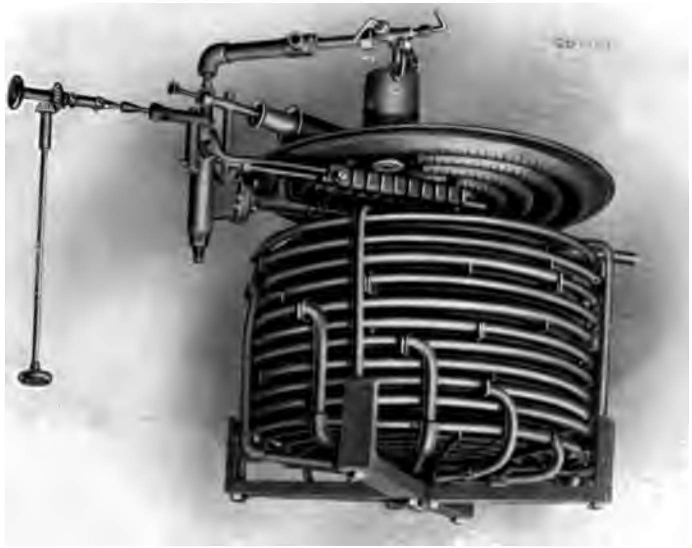
two on each side of the crank shaft. The single-acting steam engine is of course somewhat similar to the petrol engine, except that in place of the explosions of vapour, steam at high pressure is regularly supplied to the cylinders. The admission of steam to the cylinders of the Serpollet engine is governed by mushroom valves, which are opened at the proper moment of the stroke by means of cams placed on a secondary shaft. This shaft is geared to the crank shaft in such a way that the moment of admission of the steam to the cylinders can be varied by the driver, so that he can either use the steam expansively, cut it off, or reverse the movement of the engine. There is in addition an ordinary throttle valve governing the supply of steam to the engine, and this is controlled by a pedal.

The system of controlling the supply of water to the boiler and fuel to the furnace is extremely interesting. The fuel is ordinary petroleum, and this is stored in a tank under air pressure. On its way to the burner the petroleum passes through a perforated plate which can be opened or closed by the movement of a slide similarly perforated. When it is fully open the oil can pass through all the perforations; when it is closed the oil only passes through one small aperture which admits just enough to keep the burner alight. The slide has three other fixed positions, each of which admits a certain amount of petroleum an hour, so that it is impossible, according to the speed at which the car is running, to pass too much oil to the burners; it is indeed unnecessary to think about it. The same lever which controls this slide controls also another slide which governs the admission of water to the generator. The quantity of water turned into steam is thus made to correspond exactly, in a definite mathematical proportion, with the quantity of fuel delivered to the furnace. The water is delivered by a pump worked by an eccentric from the back axle. The Serpollet car is an extremely fast one, and, of course, perfectly silent and smooth in its working, the only sound to be heard being the deep roaring of the furnace when the car is travelling at high speeds. The Serpollet was until recently the only rival of the heavy-powered petrol cars on the market, with the exception of the "Miesse" steam car, which has for its generator a single-coiled tube, and has a three-cylindered single-acting engine. A new pattern of the Serpollet car is made in

three sizes—40 h.p., 15 h.p., and 9 h.p. respectively, but its cost—which is not excessive, considering the beauty and perfection of the workmanship employed in it—places it beyond the reach of many of its admirers.

THE WHITE STEAM CAR

Of quite another type is the White steam car, which is built in one size only, 10 h.p., and is sold at a price which brings it within the reach of many to whom the price of the Serpollet car is prohibitive. It presents features of unusual interest. It is a steam car, yet it is not expensive; it carries four people; it can run for long distances without taking in supplies; it is extremely simple in construction, is easily managed, and inexpensively maintained; and it can keep up an average speed of twenty to twenty-five miles an hour throughout a day's run. The frame is constructed on standard lines. The bonnet in front covers the engine, condenser, and oil separator. The generator is fixed under the front seat, the chimney being arranged in T-shaped flues on each side of the car, while in other respects it resembles in arrangement the ordinary type of petrol car. The drive is direct through a simple shaft fitted with universal joints to the live rear axle, there being, of course, no clutches or change-speed gears. The generator consists of helical coils of seamless tubing placed one above the other and surrounded by a casing of insulating material. The coils of tubing are so connected that the water entering at the top cannot pass through the successive coils below by gravity, but is held in place entirely subject to the action of the pump. The chief point about this arrangement is that we have thus a steam generator in which none of the conditions of a steam boiler exist. The water is always at the top of the coils and goes out in the form of superheated steam through the lower coils, which are immediately above the fire. There is no boiling water to generate steam, as the water is instantly flashed into steam at some variable point in the lower coils, that point depending on the amount of steam which is being used. There is no water level to be watched or maintained, and there is no possibility of burning out or of explosion, while the rapid circulation prevents the deposit of scale or crust. The water supply is con-



"WHITE" GENERATOR AND BURNER

SHOWN WITH THE ASBESTOS JACKET REMOVED. THE OUTER END OF EACH COIL IS CARRIED UP TO THE TOP OF THE GENERATOR BEFORE CONNECTING TO THE INNER END OF THE NEXT LOWER COIL, TO PREVENT THE WATER FROM RUNNING DOWN BY GRAVITY AND DISPLACING THE STEAM IN THE LOWER COILS. THE STRAIGHT RIBBED PIPE SEEN BEYOND THE VAPORIZER CONVEYS THE STEAM FROM THE LOWEST COIL ON ITS WAY TO THE ENGINE. IN THIS PIPE IS LOCATED THE THERMOSTAT, WHICH ACTUATES A VALVE CONTROLLING THE FUEL SUPPLY. IN THIS MANNER THE FIRE IS REGULATED NOT BY THE PRESSURE BUT BY THE TEMPERATURE OF THE STEAM

THE "WHITE" ENGINE

THE CYLINDERS ARE ENCASED IN AN ALUMINIUM JACKET WHICH IS FILLED WITH ASBESTOS LAGGING. THE CRANK CASE AND ALL PARTS WHICH DO NOT BEAR A WORKING STRAIN ARE OF ALUMINIUM. THE DIAPHRAGM REGULATOR WHICH ACTS UPON THE BY-PASS VALVE IS SHOWN IN THE RIGHT-HAND ILLUSTRATION, ALSO IN THE CENTRE ONE. THE CENTRE ILLUSTRATION SHEWS THE WATER PUMPS, THE RIGHT-HAND ILLUSTRATION SHOWS THE POWER AIR PUMP ENGAGED TO THE CROSS-HEAD PIN, AND THE LEFT-HAND ILLUSTRATION SHOWS THE POWER AIR PUMP DISENGAGED. THE WATER PUMPS ARE OF VERY SHORT STROKE AND ALL ARE LIBERALLY PROPORTIONED. THE ROCKER ARM ON THE TOP OF THE CYLINDERS OPERATES THE SIMPLING DEVICE WHEREBY THE LOW CYLINDER RECEIVES HIGH PRESSURE STEAM

trolled automatically by the steam pressure, thus doing away with any hand regulation of the pump by the operator. The steam is superheated, since it comes out of the hot tubes immediately over the fire; and its expansive power is therefore very great. The water supply is regulated by the steam pressure, and is entirely automatic. The car can indeed be run until either the water supply or the fuel is exhausted, when the only thing that will happen will be that the car will come to a stop. In this way it is almost impossible to damage the "White" car by carelessness or forgetfulness in driving.

The engine is a compound one, the cylinders being 5 by 3½ inches and 3 by 3½ inches respectively. It is so arranged that it can be changed by the pressure of a foot pedal to a simple engine, in which case both cylinders are running at high pressure. This of course is only used in starting or when a specially strong pull is required. Whether there is any real increase in efficiency obtained by compounding so small an engine is a matter of some doubt, although theoretically there should be a gain. The cylinders are insulated and covered with an aluminium jacket. The cranks work in an aluminium dust-proof case in which there is a bath of oil, so that the maximum of lubrication and the minimum of dirt are attained. An eccentric operates, through a rocking arm, the double-ended plunger of the feed pump and the condenser pump attached to the left-hand side of the engine, as seen in the illustration. The diaphragm regulator controlling the bye-pass valve is connected directly to the upper or feed pump. When this valve is opened, the water, instead of being forced into the generator, returns directly to the bottom of the pump, and so circulates locally until the bye-pass valve is closed. From the engine the exhaust steam proceeds to the condenser at the front of the bonnet; thence in the form of water it goes to the oil separator, where the cylinder oil is removed, and so back to the tank.

The burner, which consists of a top plate of cast-iron in which are a number of concentric circular corrugations perforated for the passage of the gas, is fixed directly under the generator. The bottom of the burner consists of a sheet-iron plate slightly conical in form, with its lowest point in the centre. The fire is started by means of a pilot light, which is separate from the burner, and is started by allowing liquid petrol to run

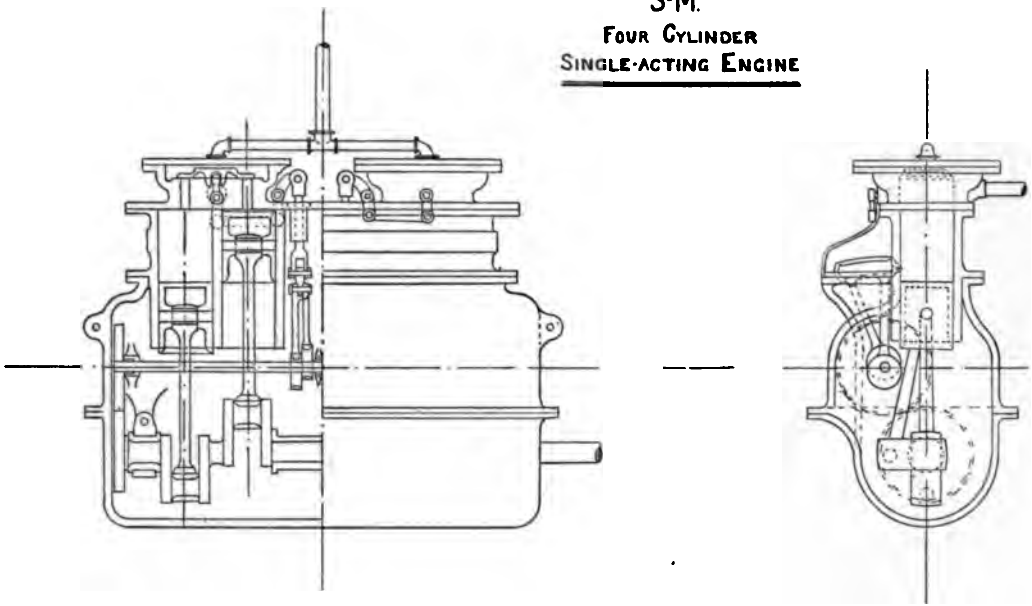
into an annular drip-pan. About three minutes are required to heat the vaporiser by means of the pilot light, after which the main burner valve is opened. In another thirty seconds the car is ready to run. The pilot light remains cut down to a small blue flame, so that no matter how long the car remains standing, the driver can start it again from his seat. The engine is reversed by the ordinary link motion, and by a proper use of the reversing lever can be "notched up" so as to achieve some small economy in the fuel and water. The engine is automatically lubricated, and develops something over the advertised 10 h.p.

THE S.-M. STEAM CAR

The latest form of the application of steam-power to motor-cars is, unlike the White and the Serpollet, an entirely English design. The car is the design of Mr. George J. Shave, who for some years has been works manager to the Locomobile Co. of Great Britain, and the flash boiler with water and fire control is the joint patent of Mr. Shave and Mr. Irving J. Morse. This flash generator and its control constitute one of the cleverest advances that has yet been made in steam work as applied to motors. It is absolutely automatic, and ensures a constant pressure of steam under all circumstances. This car and its various component parts have been subjected to a two years' trial of the severest description before the publication of any details, and the fruits of so much care and preparation are visible in the remarkably simple, powerful, and inexpensive car which is, I understand, being manufactured by the company which has succeeded the Locomobile Company, and is under new management.

The principle of the car is somewhat similar to that of the Gardner-Serpollet, but it is far more simple, as well as being quite different in the arrangement of its parts. The four-cylinder single-acting engine is placed vertically under a bonnet in front of the car, where it is surrounded by a water-tank. The crank chamber is entirely enclosed, and the big-ends and shafts run in graphite grease. The engine drives direct to a differential shaft situated under the frame a little to the rear of the middle of the car. From this differential shaft eccentrics work the various pumps, and from it also the rear wheels are

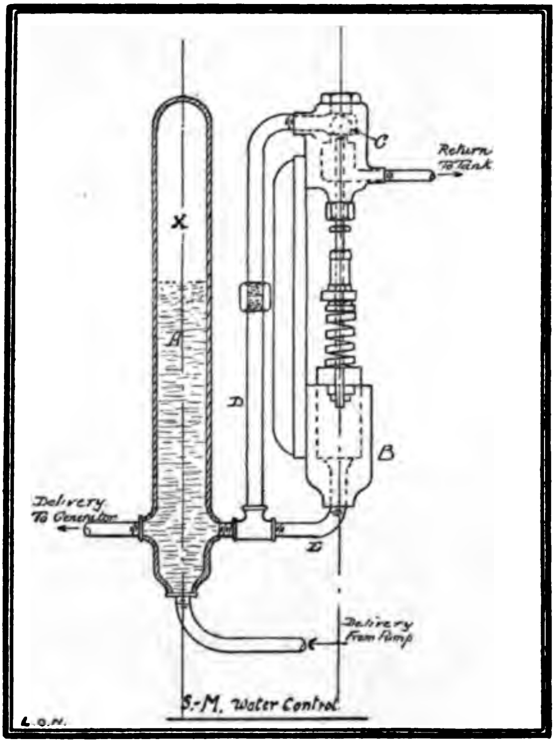
"S-M."
FOUR CYLINDER
SINGLE-ACTING ENGINE



driven by means of outside sprockets and chains. The remarkable simplicity of the car is its strong point. Unlike the ordinary boiler, the generator contains no water at all, but only steam; and unlike other flash generators, it always contains a reserve of steam. The water enters the heated tubes at the bottom, is flashed into steam, travels upwards through a series of tubes (some 200 feet in all), passes down again, and then enters the outside coils, where there is always a reserve of steam. The water is delivered to the boiler by a very large feed pump, which works continuously by means of an eccentric from the differential shaft, and its entrance to the boiler is regulated by an extremely ingenious arrangement which is shown in the accompanying drawing.

This water control is so designed that on the steam reaching any given pressure, which can be determined and altered by adjustment, the water is returned to the tank and no more enters the generator until the pressure falls below the fixed point. At the top of this water-bottle there is always a cushion of air at exactly the same pressure as that of the steam in the boiler; and on the car being stopped and the control mechanism locked, this air pressure remains constant at exactly the steam pressure which existed at the moment the car stopped. The fire is cut down with the same movement as shuts off the steam, and leaves a pilot light burning with just sufficient strength to keep the generator hot. So that supposing even that the car has been left standing for three or four hours, all that is necessary for the operator when he returns is to unlock the control, when the air pressure in the bottle immediately forces the water into the generator, and there is instantaneously produced a pressure of steam practically equal to that existing when the car was brought to rest. The fire is opened at the first movement of the throttle, and the process of steam generation is carried on automatically. In the drawing A represents a water-bottle into which is forced water through the delivery pipe from the pump. From the water-bottle the water circulates through a pipe to the generator and continues to do so until the pressure in the generator reaches the point that the control is fixed at. At that point the check valve which is inserted in the pipe between the bottle and the generator closes, and the water pressure then acts on a plunger (B)

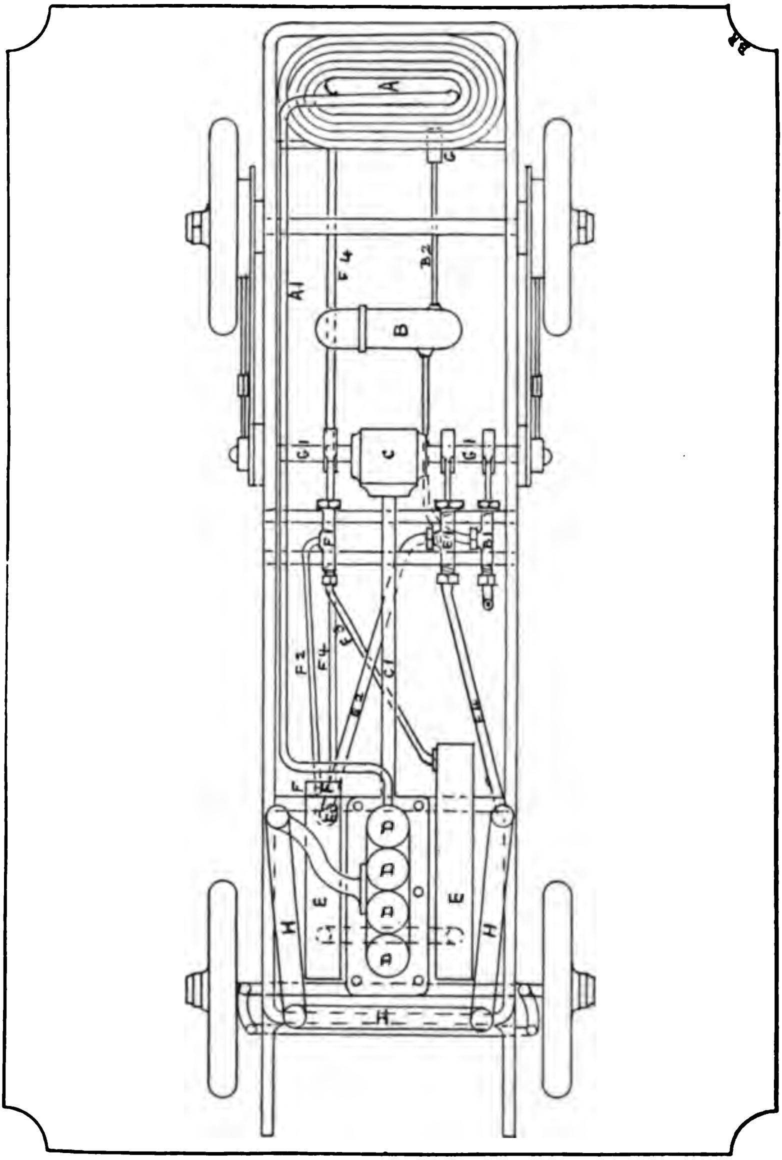
which raises a spindle and lifts a steel ball off its seating at C ; the water then runs back to the tank. Immediately the pressure in the generator drops below the point at which the control is set, the ball reseats itself, the water again circulates to the generator, and thus the pressure is maintained. X is the air space in the water-bottle which ensures an easy flow and



PATENT CONTROL OF THE S.-M. CAR

no jerky movement of the steam gauge. By the closing of the valve between the water-bottle and the generator when the car is stopped, this water in the water-bottle is retained under pressure.

The driving of the car is by a slide throttle, which also regulates the supply of fuel to the furnace. The accelerator, actuated by means of a pedal, closes off the automatic control, so that the whole of the water supplied by the pump is de-



PLAN OF S.-M. CHASSIS

A—Generator.
A^1—Steam-pipe.
B—Small Paraffin Tank, under pressure (main tank not shown).
B^1—Paraffin Pump.
B^2—Paraffin Supply to Burner.
C—Differential Gear.

C^1—Driving Shaft.
D—Engine.
E E—Water Tanks.
E^1—Return Water Pump.
E^2— ,, ,, Delivery Pipe.
E^3—Filter.
E^4—Suction Pipe from Radiator.

F—Feed-water Control.
F^1— ,, Pump.
F^2— ,, Delivery Pump.
F^3— ,, Suction Pipe.
F^4— ,, Supply Pipe to Generator.
G—Fire Control.
G^1—Differential Shaft.
H—Radiator.

livered to the generator, instead of being bye-passed back to the tank. This gives an instantaneous increase of steam pressure in the generator and consequently of power in the engine.

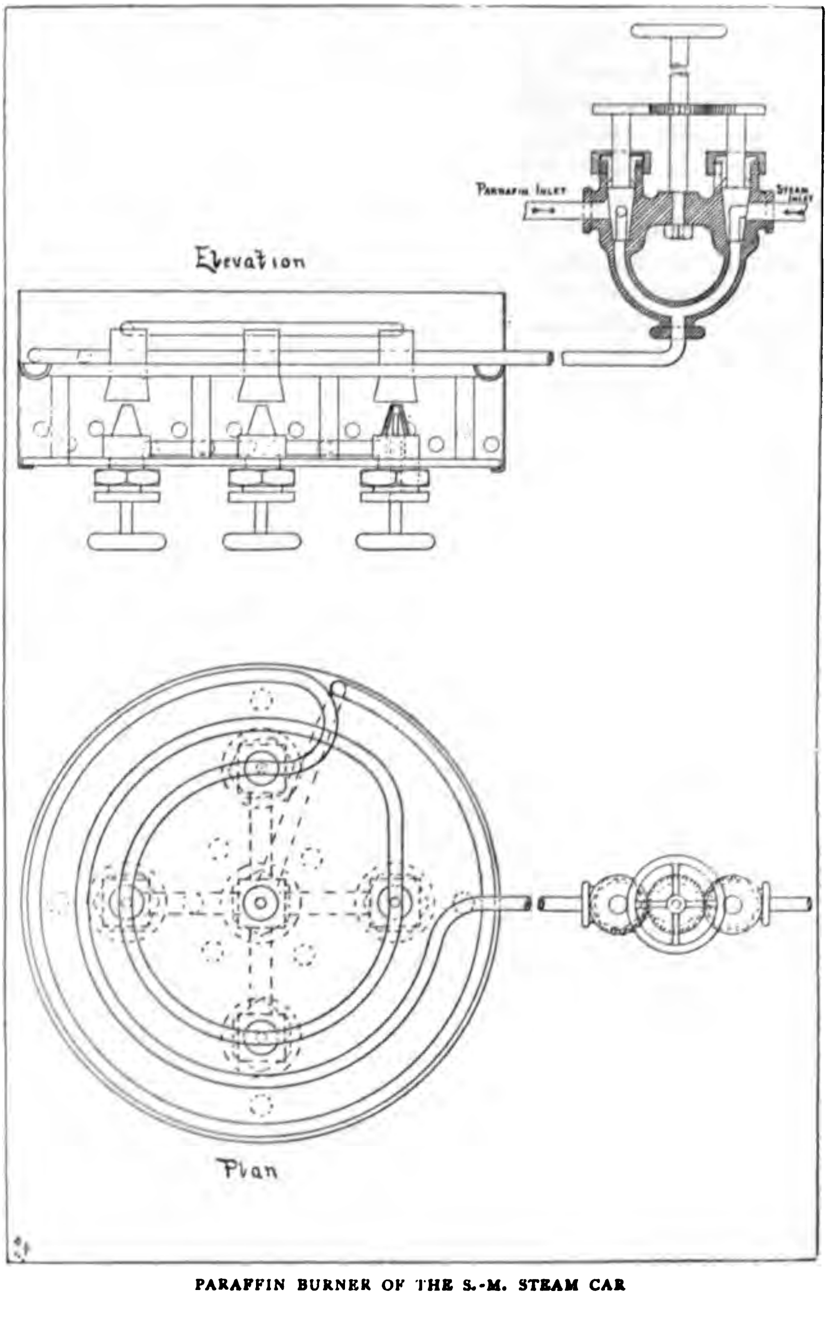
The steam, on passing out of the exhaust, is led at once into the large radiator within the bonnet, whence it is drawn by a third pump driven from the differential shaft and discharged in the form of water into the water-tank. The specially large pump which draws it from the radiator into the water-tank does away with any possibility of back pressure, as it is so powerful that it tends almost to create a vacuum in the condenser and so to suck out the exhaust steam from the engine with considerable power. The filtering arrangements are very simple, consisting merely of a small wad of waste which it is only necessary to renew after every run of two hundred miles. The water and paraffin carried will take the car at least the same distance, the consumption of paraffin being approximately one gallon to every twenty miles. This range is unprecedented in a steam car, and exceeds that of many petrol cars. The engine here described, the cylinders of which are 2½ inches in diameter by 3½ inches stroke, develops normally 8½ h.p., and can drive the car at a speed of forty miles an hour. The engine of the 20 h.p. car is a little larger, and the transmission gear much stronger, as this car is capable of very high speeds. I believe Mr. Shave is the first motor-car engineer to reinforce his crank shaft gradually towards the rear end, where the twisting strain is far greater. In a four-cylinder car the strains are cumulative to the rearward crank, and in the S.-M. car there is a difference of ¼ inch in the diameter of the front and rear bearings of the crank shaft.

The frame of the chassis is the ordinary pressed steel frame as generally used on a petrol car; and the low centre of gravity and long wheel-base—9 feet 6 inches—help the beautifully smooth running of the machine. There are the usual brakes on the differential shaft and on the rear driving wheels themselves. Lubrication is positive and automatic to all the working parts; and the steam itself is lubricated, oil being automatically pumped into the main steam pipe just before the point at which it enters the steam chest, ensuring an equal distribution through all four valves. The few simple controlling levers are at the

operator's right hand and on the steering post, while the pressure gauges and lubricating taps are all brought on to the dashboard immediately in front of him. The car is fitted with a phaeton body and is supplied either with an 8 h.p. engine or a 20 h.p. engine, although for the needs of all ordinary motorists the 8 h.p. car is amply sufficient. There are no spindles working through glands, so that the old continuous trouble of steam cars is done away with. The only glands are those working the slide valves; but as these are actuated by a lever working through the exhaust port, and the spindle which works in the gland has a rotary motion only, there can be no trouble from packing in this gland. The ordinary Stephenson link motion is employed for reversing, and for linking up the engine for the purpose of economising steam on level roads.

The paraffin burner designed for this car by Mr. Shave is a triumph of efficiency and simplicity. Everyone who has had to do with paraffin burners knows the drawbacks that have hitherto distinguished them; and that smell, dirt, and the continual choking up of the nozzles and holes of the burner were not the least of their disadvantages. In the new design all these troubles have disappeared. His paraffin burner consists of a simple coiled steel tube through which the paraffin runs and in which it is vaporised. Six velocity nozzles project vertically underneath the fire-box and spray the vapour through six 1-inch mixing tubes, which draw air from two rows of perforations in the surrounding case of the burner. By this all possibility of noise and back-fire is done away with. The burner is, in fact, a true Bunsen burner of the simplest type. A small circular trough is fixed underneath the steel coil, and this trough is filled with methylated spirit for the purpose of starting the burner.

It is in the construction of the nozzles, and in a device for cleaning the burner, that the ingenuity of this device is most clearly shown. As the great trouble of such a burner is likely to be the choking of the nozzles, the designer has combined with the valves which open and close them a fine steel needle which, when the valves are screwed up, is forced through the nozzles and absolutely clears them out. Every time, therefore, that the valves are opened for the purpose of starting the



PARAFFIN BURNER OF THE S.-M. STEAM CAR

burner, the nozzles are found in as clean and open a condition as when they left the shop. Provision is also made for blowing steam through the burner by means of a valve fitted at a point in the pipe conveying paraffin to the burner. If this valve is open to paraffin it is closed to steam; but on shutting off the paraffin after a run, the steam which remains in the generator is allowed to blow right through the burner and so assist in keeping it absolutely clear and clean. Although there is no position in which this tap is open both to steam and paraffin, there is a position in which it is closed to both. The tanks which supply the burner are of ample size, but only a small one is used for containing the paraffin under pressure, supplies for this tank being automatically pumped from the main supply.

A very careful study of this car, both in general design and in detail, has convinced me that in it virtually all the disadvantages of the steam engine as compared with the petrol motor have been eliminated, and that the universally admitted advantages of steam are given their full value. A non-stop range of from 200 to 250 miles is surely enough for the most ardent motorist, while the simplicity of the engine and the working parts will make the car an extremely cheap one to run. So far as I can see, there is practically nothing that can wear out. All the bearings, including those on the four road wheels, are, with one exception, plain bearings of large size; the exception is the ball-thrust bearing on the universally jointed driving shaft, which is the only ball bearing on the car. The valves have so small and simple a motion that there can be practically no wear in their gear; the generator cannot be burnt or scaled; the pumps, being large and slow-moving, should be almost indestructible; while the engine itself represents motive power reduced to the very elements of simplicity. So that with power, smoothness, elasticity, silence, simplicity, ease of control, cheapness of first cost and upkeep combined in one vehicle, there does not seem to be much room for defects. The great simplicity of the "S.-M." car, together with the fact that it is completely automatic and that it contains practically nothing that can wear out or give trouble, differentiates it from every other make of steam car, and ought to do much to restore steam to that position in the favour of motorists which it has recently lost.

CHAPTER VI

ELECTRIC CARS

An infant science—Where is Mr. Edison's accumulator?—The ideal town carriage—The Electromobile—A luxurious carriage—The City and Suburban electric cars—Taking an electric brougham to the country—The care of batteries—Two golden rules.

SO far as general utility is concerned, electric motor-cars are in an infinitely less advanced condition of development than either steam or petrol cars. There is practically only one system of applying the motive power, and that is by means of electricity stored in accumulators which are carried on the car itself. The current thus stored is passed into an electric motor or reversed dynamo, the principle of which consists of a series of insulated wires revolving in a magnetic field. This motor either drives through gearing to the rear wheels in the usual way, or there may be two motors, one mounted on each of the front wheels, so that no transmission shaft or gearing is necessary. The car is driven and the speed altered by means of a switch placed on the steering pillar, which alters the power of the motor, reverses it altogether, or by turning it into a dynamo, causes it to act as a powerful brake. In spite of the boast of Mr. Edison's friends, no system has yet been invented for storing electricity lightly, inexpensively, and in small compass; the result is that electric cars have to carry a great dead weight about with them, and in addition are limited to a comparatively small range of activity, the average of which may be taken as forty or fifty miles. And such a car, if its store of electricity gives out at any place other than an electric charging station, is helpless.

Until, therefore, the new method of storing electricity, which is the goal of all electrical invention at the present day, is

discovered, electric motor-cars must remain useless for all but certain specialised purposes, such purposes being compatible with a very limited radius of activity. Within these limits, however, the electric motor-car presents certain obvious advantages. Electricity is silent, invisible, and perfectly smooth in its action; it can be set to work by the movement of a switch; it is always ready, needing no preparation for work and requiring no skill in its control; and it is as clean as it is invisible. Such qualities mark it out as specially suitable for the purpose of driving town carriages or broughams, in the use of which there is more starting and stopping in proportion to the distance travelled than in that of any other private vehicle, in which silence and smoothness of running are essential qualities, and where anything like oil, dirt, or visible and malodorous vapour are intolerable. For such a purpose the electric motor is eminently adapted, and for such a purpose it is almost exclusively used in this country. All Londoners are familiar with the long lines of electric broughams, landaus, and victorias in Hyde Park and in the West End streets; in fact, between the hours of midday and midnight it would be difficult to get a view of any West End thoroughfare in which one or more of them were not included. For dwellers in country-houses where there is an electric lighting plant the use of electric carriages is, of course, quite possible; and for ladies or invalids who wish to drive themselves about a park or estate there is a great utility in a low-hung electric run-about geared to a low speed, for it is practically the only motor vehicle which can be driven safely by nervous or invalid people. But beyond this, electric motor-cars have practically no advantages for country work in which they are not surpassed by steam or petrol vehicles; and their disadvantages and limitations are so grave as to put them practically out of the running of anything but town work.

The usual method of working an electric carriage is, as I have said, by means of accumulators which are charged from a main electric current. These accumulators generally consist of an even number of cells, each one of which forms by itself a complete electric unit, with positive and negative poles. This cell consists of a glass or ebonite jar containing two sets of lead plates—one a positive plate, the other a negative—which are

ELECTROMOBILE LANDAULET—CLOSED

ELECTROMOBILE LANDAULET—OPEN

electrically insulated from each other. The cell is filled with a dilute solution of sulphuric acid; and when the cell has been charged, it will store up an electric current which is given off when a wire from the positive plate is connected with a wire from the negative plate. By connecting groups of these cells in various ways, different pressures of current can be obtained from them. Cells are said to be connected in parallel when all the positive plates are formed by the wire and all the negative plates by another; they are said to be connected in series when the positive plate of each cell is connected to the negative plate of the next.

The current thus obtained is passed into the motor—a contrivance in which the magnetic properties of the electric poles are employed to revolve a drum of coiled wire. The principle that opposite poles attract each other is utilised by means of a mechanism which alternately produces in a piece of metal a north and south pole, a circular movement being thus set up which persists so long as the current is flowing through the motor.

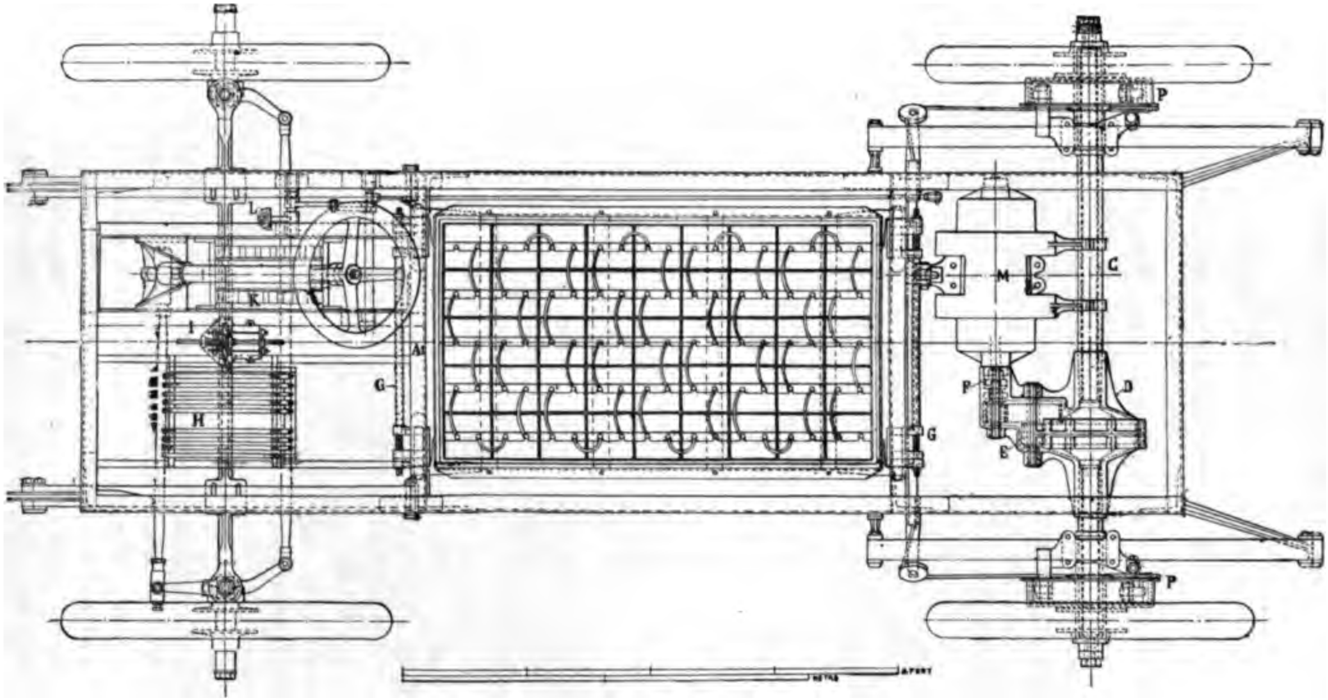
There are many forms of carriage in which this principle is applied; and in America especially there has been a great vogue in light electric "run-abouts," such as I have already referred to. In England, however, these are comparatively little used, and the form in which the electric vehicle is best known and most popular is that of the town brougham or landau. The two chief forms of electric carriages used in this country are those of the Electromobile Company and of the City and Suburban Electric Carriage Company.

THE ELECTROMOBILE

The Electromobile cars are made in three types—the Landaulette for two or four people, the Brougham, and the Victoria. All these, however, are mounted on one type of chassis, the arrangement of which is shown in the accompanying plan. The battery (the case containing the accumulators) is slung under the frame in the middle of the carriage, and consists of forty-four cells of a special, light, pasted type. Its capacity is 135 ampère hours, which gives a running of thirty or forty miles. Its position under the carriage assists materially in the

prevention of side-slip, as its weight (about 10 cwt.) brings the centre of gravity down very low. It also assists in the rapid interchange of batteries, as in the Electromobile garage the accumulator box is lowered from its position by a hydraulic lift and one freshly charged put in its place, the whole operation occupying only three or four minutes. Unlike the City and Suburban carriages, the Electromobile is driven by a single motor of 8 b.h.p., which for short periods can exert over 16 h.p. It is of the ironclad type, bi-polar, and wound in series, having two separate commutators connected to separate armature winding. The arrangement of field castings and bobbins avoids all magnetic joints and results in a total suppression of sparking. It drives through a double train of double helical gearing to the differential on the rear axle, and thence to the hubs of the rear wheels by live shafts. The entire motor, gear, and shafting are enclosed; the gear runs in oil which is thereby circulated through the bearings, and can only escape after reaching the hubs of the road wheels. The controller gives forward speeds ranging from three to fifteen miles an hour, two electric brakes, and one reverse speed. Steering is by a wheel and spindle working through bevelled gearing to the road wheels. There is a powerful expanding foot brake working in sheaves forming part of the hubs on the rear wheel, the pedal being so arranged that before the brake is applied the electric current is cut out.

The principal features of the Electromobiles are the excellence of their design, which places the driver's seat low down, where he does not obscure the view from the front windows, the great comfort and luxury of the carriages, and the simplicity of the driving mechanism and the soundness of its workmanship, which is English throughout. Tyres of an exceptionally large diameter are fitted to these carriages and add much to the luxury and comfort of their running. The carriage work is first-rate in every way, and my own experience of the Electromobile vehicles is that they represent the acme of smartness and luxury that can be attained in a town motor-car.



PLAN OF ELECTROMOBILE CHASSIS

A1—Cross-bar.
C—Live Axle.
D—Differential Gear.

E—Reducing Gear.
F—Oldham Coupling.
G—Battery Suspension.

H—Starting Rheostat.
I—Pedal Switch.
K—Controller.

L—Brake Pedal.
M—Motor.
P P—Brakes.

THE CITY AND SUBURBAN COMPANY'S CARRIAGES

The City and Suburban electric motor-cars do not differ very greatly from those of the Electromobile Company, the chief points of difference being that they are driven by two motors instead of one, each motor being geared directly to one of the back wheels, and the batteries, instead of being slung in a cradle underneath the car, are placed in cases in front and behind the carriage body. The makers claim that the advantage of this system outweighs its disadvantages, although, so far as the distribution of weight is concerned, the ideal system is that of the underslung battery. But the City and Suburban Company find that many of their customers like to take their carriages to the country, and in that case the accessibility of the batteries becomes an important matter. Without a specially constructed mechanical lift it is difficult to get at the underslung battery for the purposes of examination, replating, etc. Whereas when the batteries are placed in external cases they can be removed in a moment. The original design of the City and Suburban carriages was very much that of an ordinary brougham, the driver being situated on a high box in front, and it is in this form that these carriages are most familiar. The advantage claimed for this somewhat unsightly arrangement is a very substantial one, namely, that in case it is necessary to reverse the carriage in a crowded street, the driver can see over the top and judge what room is available for the backward movement. In some of the later carriages, however, such as that illustrated, the company has adopted the lower and more sightly position for the driver's seat which is characteristic of the Electromobile carriages. Any disadvantage which this arrangement may have in crowded traffic could, I think, be eliminated by the use of a mirror so fixed on the edge of the dashboard as to show to the driver the position of the traffic behind him.

The usual equipment of a town landaulet is a 44-cell battery, which is placed in a wooden tray and slid into the car, the control being effected by a drum which varies the connections of the batteries. On the first speed the two sets of batteries, each consisting of twenty-two cells, are connected in parallel and give only half the possible voltage. The current is led into

A NEW TYPE OF CITY AND SUBURBAN ELECTRIC CARRIAGE

the controller from the positive poles of the battery, and they are joined by the brass contacts on the controller drum. The current passes from the controller to the armature of one of the motors, after which it passes to the field winding, and then back to the negative contacts of the battery. In the second speed the two sets of cells are connected in series, but the current is delivered to both motors simultaneously instead of passing through one to the other. Special cut-outs and plugs are provided which make it impossible for the carriage to be run in the absence of the operator, and very efficient brakes are provided. The reverse is actuated by a foot pedal, and the forward speeds by a handle. The admirable housing and charging accommodation of the City and Suburban Company at "Niagara," Westminster, ensure to the owner of one of their carriages the most careful and expert supervision, as well as every facility for the charging and repair of the batteries.

The care and adjustment of electric vehicles is so delicate a matter, and requires so considerable a scientific knowledge, that the less the amateur meddles with it the better. But there are one or two simple matters which may be pointed out to those owners of electric carriages who take them periodically into the country away from the supervision of the makers. No carriage, to begin with, should be taken into the country without the battery being first examined to see that it does not require replating. This, in the case of the carriages in daily use in town, and running on the average twenty or twenty-five miles a day, is necessary every four months; and if the battery is run longer than this without attention, there is danger that the corrosion of the plates, by precipitating a metallic deposit to the bottom of the cells, may make contact between their poles, and so short-circuit the battery. There are also two golden rules to be observed in the care of electric accumulators of any kind; one is that the less the battery is run down before it is recharged the longer will be its life; the other is that the lower the rate at which the battery is charged the better. The batteries of an electric brougham or landau should be charged, when time permits, with a current of 10 ampères. Where there are two batteries they can be charged in parallel, and in that case the current may be of 40 ampères. Overcharging, except in the case of an entirely exhausted battery, is damaging; and

even in the case of an exhausted battery the overcharging should on no account be at the rate of more than 10 ampères. The 44-cell battery should not be charged higher than 115 volts, or discharged lower than 75 volts; but to attain a voltage of 115 on the charging wire being disconnected, it will be necessary to charge up to about 120 volts, as the pressure will fall as soon as the charging wires are uncoupled. The battery is charged when the liquid contained in the cells is freely covered with the bubbles caused by the gas which is given off by the plates. In the case of cars which, like those of the City and Suburban Company, are driven by motors geared directly to the road wheels, a certain amount of rattling is after a time developed, owing to the wear on the pinions. This is one of the disadvantages of this system, and has in the past been practically unavoidable; but I am told that the City and Suburban Company have been for some time experimenting with pinions composed of various materials, and that they have now found a material by the use of which they hope this trouble may be abolished.

CHAPTER VII

THE SELECTION OF A MOTOR-CAR

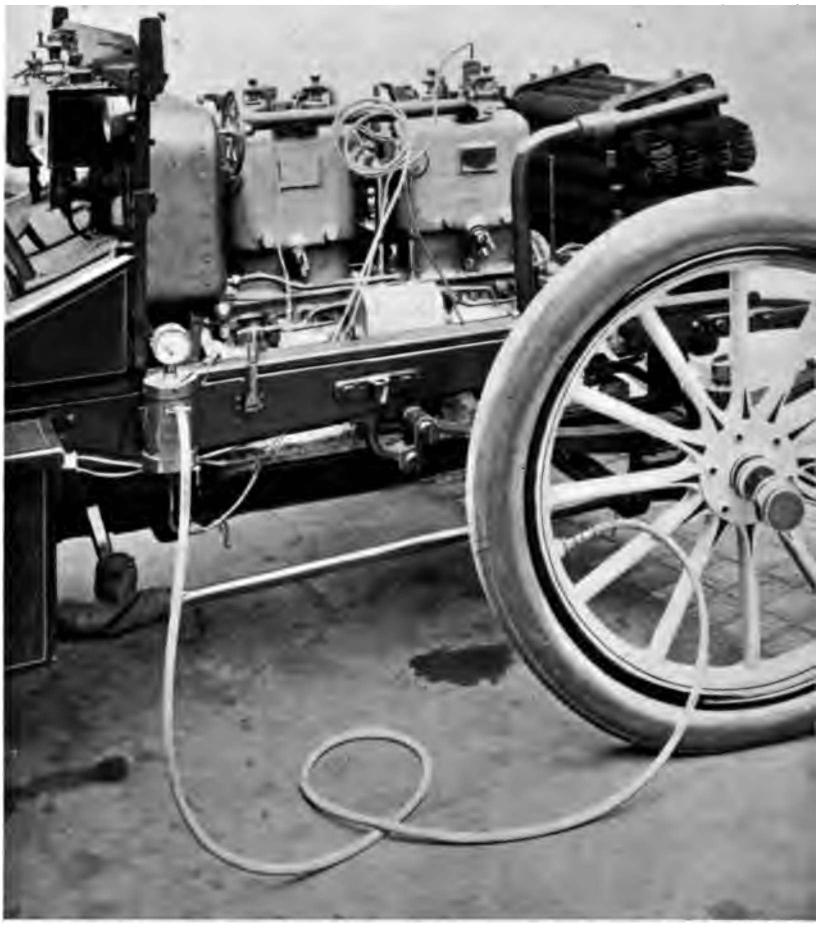
A bewildering question—The future of the cheap car—Two hundred pounds a minimum price for a touring car—Cars made to sell and cars made to use—The second-hand car—A difficult question—The horse-power of a car—Its influence on cost of up-keep—Which car?—A formidable list—Advice to a millionaire—The poor man's problem—Donkey cart or railway train?—Unfair comparisons—The common fault—An unattainable ideal—The simple car—Use big tyres—The car for a doctor—The Monday morning problem—Cars and country-houses—The station bus—Slaves of the desk—The real mission of motor-cars—The cheap motor car—Solid tyres—Their advantages and disadvantages—Where price does not matter—Buying a car—Tradesmen's vans—A proper trial—Silence or loss of power—Steam cars and hills—The dust nuisance—A simple cure—A tale of two cars—Side entrances.

IN an earlier chapter I outlined some of the difficulties which lie in wait for the happy man who is about to buy his first motor-car, and the absolute bewilderment with which the variety of choice oppresses him. My advice to anybody in such a case would always be, "Go to a disinterested expert; tell him what you want and what you want it for; and let him advise you as to the make or type of car which you ought to get." This, however, is for many people a counsel of perfection. The spending of a sum of money varying from £150 to £1,500 upon a vehicle in which one intends to travel oneself is not a thing which most men will be disposed to resign entirely to the judgment of another man; and although that is the only way in which they can be sure of getting really sound advice, the hints given in this chapter may be of service to those who insist on being their own experts, in preventing them from committing some of the grosser mistakes to which the novice at motoring is prone.

I am sorry to say, to begin with, that I do not know of any car costing less than £200 which I could guarantee would give absolute satisfaction in fulfilling the principal duties to which a

motor-car is put. That there is a great future for cars costing from £100 to £200, or even less, I think no one can doubt; in fact, the motoring of the future will, I believe, be motoring on cheap and light cars; but we have not yet been engaged in the construction of such cars long enough to be sure that we have learned quite the best way to set about designing them. There are on the market a great many cheap English cars of 5 or 6 h.p., which look very attractive in the show-rooms or on a trial run round the park, but which do not turn out to be very satisfactory with severe and regular use. And in the present condition of the automobile industry there is a great tendency to turn out cars that will sell rather than to turn out cars that will give complete satisfaction. There is one very well-known cheap car which, although it is being extensively sold at this moment, is a very far from satisfactory vehicle, and is built neither to last long nor to wear well; yet the demand for cheap cars is so great that the experience of the old purchasers of such a machine is not enough to discourage the flood of new purchasers who are daily investing in motor-cars. Moreover, many of the English cars which look so attractive in their advertisements are constructed largely from the old, discarded stock of some foreign makers, and are by no means built up of newly-designed parts.

There are, again, cheap cars which are made throughout genuinely enough from sound materials, but are constructed on the principles of large and heavy cars, and are therefore not really successful when asked to do the work of a light car. So that the purchaser of a motor-car who has less than £200 to spend, and who wishes to use his car for touring purposes, must either be content to buy a good second-hand car or to take the risk of a certain amount of trouble with a new cheap car. And in the case of the second-hand car (which under these circumstances I should prefer) it is well to remember that the advice of an expert engineer is not only well worth the fee that it would cost, but is absolutely essential. No one ignorant of horses would dream of buying a horse without the opinion of a veterinary surgeon; and yet horses are never (so to speak) bought new; they are always second or third or fourth or fifth hand, whereas under ordinary circumstances it may be assumed that there is something seriously against a second-hand motor-car until it has been proved that there is not. But by carefully



THE "POMPEESI" TYRE-INFLATING DEVICE

looking about and by securing the services of a really capable expert, a man of small means may often pick up a car that is practically as good as new for half or a third of its first cost.

This raises the further question whether, given any sum under, say, £400, it is better to buy a new car or to get hold of a second-hand one in almost new condition that would normally cost several hundred pounds more. There is this to be said against the second-hand car, that hardly any of the first-rate makes of cars, if they are moderately new and in sound condition, can be picked up very cheaply second-hand. Now and then for the man who waits there is a good bargain; but it is only now and then. Such cars as the Panhard, the Mercédès, the Daimler, or the De Dietrich are always more or less at a premium, and are rapidly bought up when they come into the market. The bulk of second-hand cars are by makers of no very great reputation, and are to be regarded by the purchaser with the very greatest suspicion.

There is this further consideration: a man may have, say, £400 to spend on a motor-car and no more. For that sum he may purchase a new 10 h.p. car which will give him real pleasure and satisfaction. Or he might, if he fell in with a lucky bargain, get the chance of a 15 or even a 20 h.p. car at second-hand for the same money. But we will suppose him, since he only has £400 to spend on the car, to be a man to whom the cost of the car's upkeep will be a consideration, and to such a man the purchase of a heavy car of large horse-power, even supposing that it worked well and proved to have been well worth the money it cost, would probably be a serious financial embarrassment. It would cost twice as much to keep up as the new 10 h.p. car which he might have had. Being a more powerful car it could be driven faster and would consume tyres and petrol at an alarming rate; it would tempt the owner into longer and more expensive journeys, the accidents and incidents of which (such as wiring for tyres, spare parts, etc.) would be much more formidable than in the case of the 10 h.p. car. There is a merciful ratio between the first cost of the car (provided it be soundly built) and what it will cost to keep it up that works in favour of the man with a small sum to spend. The £400 car may be kept and used for £150 a year; the £1,000 car will probably cost, all told, £500 a year, so that our

£400 man, who could not afford more than £100 or £200 a year for upkeep, and who should have got as a bargain a second-hand £1,000 car, would probably find himself in financial difficulties before six months were over. Except in very rare cases, I would advise a man who can spend anything over £300 to purchase a new car.

And now, indeed, we are only on the very threshold of our difficulties. What car? That is the question which is being asked every day by hundreds of people, and it is a question which no one can answer who does not know the whole circumstances of the person who is buying the car. Just to show the reader what a formidable task this selection of a motor-car is, I will give a list of cars which were exhibited at the Crystal Palace Automobile Show of 1904, with particulars and price of each, numbered and grouped according to price. The proprietors of the *Autocar*, who had this list compiled at very considerable trouble and expense, have kindly allowed me to print it. It is printed at the end of the chapter, and may conveniently be studied at this point.

I trust that the reader is sufficiently confounded by the diversities of this list. If he be a prospective purchaser he will at any rate be sobered, and will perhaps be more disposed than he would otherwise have been to listen to advice, even if it be only of a vague and negative kind. I cannot repeat too often that, though I may seem to give advice on broad lines in this chapter, my only real advice is—go to an expert whose character and knowledge are beyond question, and who does not receive commissions from any makers or sellers of motor-cars; pay him a fee and trust to his judgment. That, I repeat, is my real advice. It is, however, too simple and negative to be entirely satisfactory either to the giver or the receiver. There is hardly any pleasure equal to that of giving advice, unless it be that of disregarding it; and in these mutual pleasures I and my readers may now indulge one another.

If you are a millionaire the matter is very much simplified; you simply get the best and most expensive car on the market. I think it would be generally admitted that in such a class the Mercédès still holds the field. This so far represents the perfection of strength and endurance, silence and sweetness of running, ease of control and range of speed, soundness of

design and workmanship. It is still one of the very fastest motor-cars in the world; and it is one of the most expensive, whether to purchase or maintain. Its bill for tyres alone would more than swallow up what most of us would care to spend on the upkeep of a car altogether, but it still remains by a general consensus of opinion the best that has been so far attained, with the Panhard running it very close both in the matter of excellence and expensiveness. I am not sure, indeed, that it is the fault of the makers of the Mercédès car that it is so expensive; I imagine that it is the agents and sellers of the car who have made its price so exorbitant. But at its cheapest it is an expensive car, and probably the best that can be bought for money; therefore the advice that if you can afford to buy and keep a Mercédès, do so.

But to those who are not millionaires the problem presents itself in a much more complicated way. There is the first and generally rigid limitation of price; one wishes to spend so much and no more. That narrows the field, but not very much. Then comes the question, What is the car wanted for, and to what use is it proposed to put it? That is an absolutely essential consideration in the choice of a motor-car. Another is, How much is the owner prepared to spend on the upkeep of his car? And that again resolves itself into the question, How much does he expect it to do? Does he want a car as a substitute for a bath-chair, a donkey cart, a victoria, a brougham, or a railway train? Cars are on the market which will take the place of all these vehicles, and the invalid who wished to drive himself about in his own grounds would, even putting cost out of the question, be as badly off with a 60 h.p. Mercédès as the man who wished to tour the Continent of Europe would be with an Oldsmobile. Yet people are often most unreasonable and vague both in their expectations of what a car ought to do, and in their subsequent comparisons between the cost of a motor-car and the cost of a carriage. It is not fair to compare the cost of a machine which performs on occasion the duties of a barouche, a perambulator, a hurricane, and a railway train with the cost of a carriage and pair of horses. So that the first thing to be done in the selection of a car is to think out very clearly the desires and particulars of the owner in the way of using the car, the money he is

prepared to spend on keeping it up, and the amount of work which he expects to get out of it.

The commonest fault in the buyer of a motor-car is that he expects too much from it. Almost any type of motor-car can do so much more than any other vehicle of its size that there is often an idea in the mind of the novice that it ought to be able to do everything. But machinery, like men and horses, is capable of fatigue, of strain, and of being worn out; and every machine is calculated to do a certain amount of work, but no more. The motorist will therefore do well to ascertain what his machine is capable of, and to ask of it always a little less than that. The lower the price of a motor-car, the less (as a rule) it is capable of accomplishing both in speed and endurance. So that the man who pays a moderate price will get all the more value for his money if he saves his machine as much as possible, abstains from running it all day long at the top of its speed, and sees that it gets proper care and attention in the motor house.

We will consider one of the most usual cases first—that of the man who has not previously owned carriages of any kind, and who wishes to get a motor-car for the purpose of indulging in the new pastime. These people are often the most severe on their cars, as the owners of horse-drawn vehicles have got into the habit of considering their horses, and even their carriages, and of adjusting their work with some regard to their capacities. But the man whose first vehicle is a motor-car is apt to limit his demands upon it only by his own inclinations, which, as he is a novice and an enthusiast, are apt to be much in excess of what the car can perform. What qualities should such a man look for in his car? I may say at once that the ideal of the beginner at motoring, *i.e.* a car that will travel all day at sixty miles an hour, never need any repairs, will be easy on its tyres, carry six people and luggage, and be within the reach of the man of moderate means—is at present unattainable. But such a man may nevertheless procure a very serviceable car that will fulfil at least some of his purposes. We will assume that he himself is without expert mechanical knowledge, and proposes to keep his car under the care of an odd job man. For such a man a simple car is of great importance, partly because, as he is not unlikely to misuse it in the early days, repairs will be less

expensive than in the case of complex cars, and partly because the average inexpert motor man is human, and will be more likely to keep such a car in an efficient condition. If our friend is a business man, his car will probably be in use during the week-ends, and will chiefly be wanted for country tours, in which strength and simplicity, and ability to stand a considerable strain for short periods at a time, are qualities greatly to be desired. Appearance, although it ought to be as much studied in an inexpensive car as in a costly one, is not the most important thing; nor, I may add, is the colour of the paint nor the external finish. For such a purpose I would strongly recommend a two- or at most three-cylinder car of about 10 h.p., with simple and accessible valve gear—its accessibility is a very important point—and driven by chains rather than by a driving shaft and live axle. If the car has four speeds (and if there is an adequate throttle control three ought to be enough), the direct drive should not, in my opinion, be on the top speed, but be on the third, where it will be most used, and where its benefits will be most felt. Above all, our friend should insist on tyres of ample size being fitted throughout the car, or at any rate on the driving wheels. It will cost a little more in the first place, but it will be an economy in the end. Such a car will not be the most silent on the road, but with proper care it will do honest work and carry its owner safely and punctually over several hundred miles a week.

We will now take another case, and suppose that a motor-car is required by a doctor or other man whose duties require that he shall make a great number of short journeys in all kinds of weather, and to whom the temporary laying up of his car at intervals at all frequent would be a serious inconvenience. In this case first-class workmanship in every detail is of prime importance, and the car must be one to be relied upon. If the work required of the car is such as to necessitate a great deal of starting and stopping, I would suggest a steam car, since the petrol car is not seen to advantage under such conditions, to which, however, the steam car is admirably adapted. There is no danger of overheating, and the unpleasantness of having the engine running while the car is waiting before a house in a quiet street is avoided. In the case of a steam car, however, it is important that the car should be able to start away with

a very few minutes of preparation, as the exigencies of such work often demand a hurried setting out at untimely hours. If the doctor is not able to command the services of a mechanic at all hours, however, he must see that his steam car is equipped with a furnace that can either safely be left burning, or can easily be rekindled; as the dangers of leaving a petrol fire burning, which, should it blow out, would, by the consequent reduction of steam pressure, cause a blast of crude petrol to be given off, are many and serious.

Where a car is wanted to take the place of a carriage and pair for town work, nothing can be better than an electric brougham or landaulette, which, indeed, does the work of two or three pairs of horses. But there is one case in which motor-cars are not nearly enough used and in which they would be unfailingly useful; and that is, the case of a country-house where much entertaining is done. As long visits become more and more rare, and the habit of rushing into the country for week-ends more and more popular, the Friday or Saturday afternoon problem, to say nothing of the Monday morning problem, is becoming a very serious one in many country-house stables. With the guests arriving by train at all hours during the afternoon, the work of the horses, whether in a brougham or a station bus, is very severe, and in bad weather especially so. There is many a stable where four additional horses have to be kept for this and no other purpose—horses which possibly spend the week standing in the stable and eating their heads off. Apart from the expense of such an arrangement, the damage to the horses is both inconvenient and unpleasant to a man who cares for his animals. In this case it seems to me that a motor-car is indispensable—not, be it noted, as a rival to the stables, but as a help to them. For such a purpose I would recommend a 15 or 20 h.p. motor-car with solid rubber tyres on the driving wheels, and with a covered bus body capable of holding six people at least, and with accommodation for luggage at the top. It is a convenience also in the design of such a vehicle if a second outside seat can be placed behind the driver—say across the front of the roof—for the accommodation of servants, as in some of the old Daimler buses. A vehicle like this could carry luggage and passengers backwards and forwards all day long and never be a penny the

worse. Some people, I know, are too much afraid of their coachmen and head grooms to suggest the keeping of the motor-car after which in their hearts they hanker; but if they will try this plan as a beginning, treating the motor-car not as a serious or important vehicle in itself, but merely as a dishonoured drudge, retained to wait upon and relieve the delicate inmates of the stable, they will find opinion in the harness-room rapidly veering round in favour of the new-fangled machines; so that in time, and by the use of discretion and tact, they may see the whole of the stables adapted to the requirements of Mercédès, Panhard, and Napier, and John James himself grinding exhaust valves.

But there is a humbler, yet I venture to say a more important, class than that represented by the possessors of large country establishments, to whom the advent of the motor-car has conferred the freedom of the road, restoring to them their birthright of fresh air and sunshine, green fields and wayside pleasures. I refer to that large class of the population represented by men who toil all the week at city desks, and whose home life is lived in the dreary and cramping environment of city suburbs; men of hard work and small incomes, men, indeed, of "moderate" means, yet men on whom much of the burden of their country's life falls, and with whom the pressing problem is not how to kill time, but how to economise it; not how to make tolerable the empty hours of leisure paid for by the toil of others, but how to possess and cultivate the few daylight hours of rest which their slavery to the desk allows them. To such men as these, to their wives and families, the advent of a means of locomotion which will endow them again with the pleasures of the country and the road is nothing less than epoch-making. I speak, of course, of a class which is not in financial poverty, but dwells rather in an æsthetic and vital poverty born of the cramped and unnatural life of cities, its cramped and unnatural labours, its cramped and unnatural pleasures. Beyond the confines of the city and the suburbs, and, but for the limited services of the bicycle, beyond the ken and enjoyment of the people of whom I speak, has lain unknown and unvisited the good life of the English country-side, its spaces and silences, its winding roads and peaceful landscapes. To these the motor-car has restored thousands who had other-

wise been hopelessly engulfed in the cities. To them the possession of a vehicle which will act as a key to so much of health and pleasure is a boon the value of which it would not be easy to exaggerate. I wish I could think that a time would soon come when the price of a motor-car to be owned for such a purpose would fall well below £100; but I fear such a possibility is not yet on the horizon. Yet for the enormous numbers of people to whom the outlay of £100 is as impossible as the outlay of £1,000, there exists to-day the motor-bicycle, a marvellously efficient and trustworthy little vehicle which, with its fore-carriage or trailer, has opened up for so many the world of English roads. It is astonishing how many people earning only a pound or two a week find the means to become possessed of motor-bicycles; for such people the gradual payment system has provided a real boon. And although I despair of the motor-car as a privately owned vehicle ever being within the reach of those whom it would most benefit, I have faith in the development of the co-operative principle, which would enable dwellers in industrial districts to avail themselves of motor-cars as a means of freeing them from the towns, perhaps for the whole of their home life, but in any case for their weekly holiday.

But for those to whom the purchase of an inexpensive motor-car is by careful management just possible, the choosing of a vehicle becomes a matter of very grave importance. Perhaps a little windfall, some gift or legacy of a few hundred pounds, is to be devoted to the purpose, the cost of upkeep being charged to an income already sufficiently burdened. In such a case it is absolutely essential that the cost of maintenance should be low, and that sudden calls, such as that entailed by the purchase of expensive pneumatic tyres, should not be made on the family exchequer. In this case I am convinced that the ideal form of vehicle is a simply constructed steam car, burning paraffin oil, and fitted with solid tyres, at any rate on the back wheels. It is true that in the year 1904 no really simple and efficient steam car which is inexpensive to keep up is in popular use; but from what I have seen, and from what I know of the studies and preparations of steam engineers, I have no hesitation in saying that such cars will soon be, not only on the market, but in very general use. In the meantime, for those who distrust steam, or who wish to wait until the newest examples of steam car con-

struction have been more fully tested, the petrol car of 7 or 8 h.p. will turn out a good investment. Here again, where strict economy is essential, I recommend solid tyres on the driving wheels; but where solid tyres are used the form of transmission which employs a bevel drive on a live axle should be avoided, as the vibration is sure to loosen and damage the gear. Where solid tyres are used, a chain drive to the rear wheels is in every way preferable. For economical reasons a single-cylinder engine, simple in construction and of proved endurance, such as the De Dion, should be chosen; parts that may have to be renewed are thus reduced to a minimum, and all experimenting at the cost of the purchaser is avoided. With an 8 h.p. engine it is quite possible to fit a tonneau capable of accommodating two people, or perhaps one adult and two children; the car will thus be capable of carrying five people. It will not be very fast, fifteen miles an hour being probably its average speed, and it will not be remarkably silent; but speed and silence are luxuries, whereas fresh air is a necessity; and the users of the car will at any rate be able to see the country through which they are passing, and will have the satisfaction of knowing that they are not mortifying the other users of the road.

This is motoring at its cheapest; but between it and the matter-of-course annual purchase and use of the latest patterns of the fashionable makes of motor-cars exhibited at the shows there is a wide gap. It is filled at present by people to whom motoring is a luxury pure and simple, and who add it to their other pleasures, not indeed without considering the question of expense, but with an easy conviction that if they desire any particular kind of motor very earnestly, they will probably find the means to possess it. With these people first cost is a secondary consideration, their principal demand being for a motor-car which will carry them punctually and without breakdown, and the cost of which will be reasonable and, above all, fairly regular. To such people practically the whole range of choice in motor-cars is open; and all that the adviser can do is to inform them generally upon the "points" of a car, and to remind them that the nature of the country in which they principally travel, as well as the kind of work which they demand of their motor vehicle, should have some influence

upon their choice. The buyer of a motor-car should, to begin with, try as far as possible to shut his eyes to mere externals, by which I mean such things as paint and upholstery, and natty little contrivances such as hinged mud-guards, protected steps, patent lockers, and so forth. I know it is hard to ignore these things; I know that they have a very real virtue and attractiveness; but the time to consider them is not when one is criticising the complicated piece of mechanism comprised in a motor-car. Your old hand at horse-buying does not consider the animal offered to him only when it is covered with smart harness or standing in a palatial stable; he purges his mind of admiration, and searches only for defects. If he is tempted to enthusiasm, he conceals it like a vice; and while the seller is singing the praises of faultless manners, the buyer turns a searching eye upon knees and fetlocks. "Look at that shoulder," cries the one; but "What about those hocks?" murmurs the other.

Thus it should be in the purchase of the motor-car. The ideal method for the buyer would be to study the chassis stripped of its carriage work, and to consider that separately on its own merits. I advise, of course, only the purchase of cars built by makers with a reputation to lose, and whose work has been tried by hundreds of private owners; yet if the buyer insists upon going in for a new and untried car, there are certain things upon which he should coldly concentrate his attention. Of raw material, of the welding and forging of steel, he cannot judge; such matters can only be covered by a guarantee. But he can see at a glance if complication or simplicity is characteristic of the car's construction; if there is unusual complication he must study and decide whether the advantages which are sought to be attained by it outweigh the obvious disadvantages; if there is unusual simplicity he must assure himself that even in the attainment of so desirable a quality no real necessity has been sacrificed. Above all, he must remember that the machinery which he sees motionless and shining in the show-room will be called to travel over thousands and thousands of miles of highway, shaken by its own pulses as well as strained and disturbed by the uneven stresses of the road; and he must be on his guard against any arrangement, however desirable and ingenious, which is likely to be disturbed or rendered useless in the great discipline of use and wear.

DE DIETRICH COMMERCIAL WAGGON

It is strange that while the use of motor-cars for pleasure and for heavy haulage work has developed so rapidly during the last few years, the ordinary tradesman should still be reluctant to avail himself of a cheap means of transit by which the extent of his business can be so widely increased. This is especially remarkable because nearly all the uncertainties and expenses associated with the motor-car exist only in connection with those refinements by means of which high speed is attained. The tradesman's light delivery-van need never travel at more than fifteen miles an hour, and the use of pneumatic tyres is altogether unnecessary. All that is wanted is a simple engine of 6 or 8 h.p. fitted with two forward speeds and a reverse and mounted on a light van. Such a vehicle is easily obtainable at an outside cost of £250; and if there were any large demand, it could probably be reduced to £150. I venture to say that it would be a far less objectionable element in suburban traffic than the violently driven butcher's cart with its trays of meat exposed to the air—to mention only one of the many instances in which tradesmen employ carts and horses where they might with greater advantage employ motor-cars. Moreover, there is hardly any domestic tradesman—whether milkman, florist, baker, grocer, fishmonger, chemist, draper, or milliner—whose business is not greatly benefited by a system which enables him to deliver his goods rapidly at any time of the day throughout a wide radius. With the average small establishment employing a horse and van this is impossible more than once or at most twice a day; but the motor-car, which does not need time for meals and does not get tired, is always ready to "run with a message," and can profitably deliver small or large parcels at a great distance.

There is a good deal of unintentional cruelty to horses practised amongst small tradespeople, who are often obliged to overwork their animals for fear of losing customers through late deliveries; and this also would disappear if light motor delivery-vans were more often used. In London especially, and in the surrounding districts where people expect to get a daily delivery at their doors from the stores, even when they live eighteen or twenty miles away from town, the use of motor delivery-vans could not fail to be useful. I do not know, for example, how many horses, vans, and men Messrs. Carter Paterson

and Co. employ in their excellent service, but I am sure that for the same money which they now spend they could establish a perfectly efficient motor service that would extend the range of their business very widely. All that is necessary is the enterprise and business ability to organise and establish the change, and there is a fortune waiting for the motor manufacturer who will specialise in a cheap, strong, and simple chassis fitted either with a single-cylinder engine of 6 h.p. or a double-cylinder engine of 12 h.p., the chassis to be mounted on wheels fitted with solid tyres and adapted for receiving various kinds of van bodies suitable to the various needs of his customers. In the meantime, for those who desire such vans, I would recommend the use of an engine such as the 6 h.p. De Dion, or the Roots Oil Engine, which, as it uses common paraffin, is exceedingly cheap to run.

The first test of a motor-car is, of course, the test of the road. A car should be given a good trial of not less than a hundred miles on what is called a give-and-take road, and the possible purchaser should study very carefully its behaviour during this test. If any adjustments have to be made he should satisfy himself as to whether they are rendered necessary by the ordinary shaking-down process incidental to all newly assembled machinery, or whether they are due to inherent imperfections of design or construction. The loosening of a bolt, however drastic its effect upon the running of a car, may mean nothing; but irregularities of speed, difficulties in gear changing, heating of the engine, difficulty in starting, although they may have comparatively little effect upon the day's run, may possibly mean a great deal. Another point that is of the first importance in a petrol car is that all parts liable to wear and to need readjustment should be easily accessible without the unscrewing of numberless bolts and the unbuilding of half the car. Such things as inlet and exhaust valves, commutators, water-pumps, clutch springs, and gear-cases should all be easily exposed and got at for purposes of examination and repair. Lubrication should be positive and efficient, and the oil should be conveyed through pipes of decently large diameter. Steering gear should be strong and simple, with some provision for the taking up of wear. The breaking of steering gear while a car is travelling may not improbably have fatal results, while

THORNYCROFT COVERED STEAM VAN

THORNYCROFT LIGHT DELIVERY VAN

nothing is more unpleasant than very loose steering connections which allow of much back-lash in the wheel. All nuts should be of what is known as the "castellated" type, and secured by split pins. The engine and its gearing should be protected underneath by a screen from dust and mud; in fact, the more the moving parts of a car are dust-proof and oil-retaining the better it will run. Oil and grease cups of a liberal size should feed all bearings which are not automatically lubricated, and the wiring of the ignition system should be as simple and as well insulated as possible.

Silence is an important matter in a motor-car, as noise generally means wear and lost power. But there are two distinct sources of noise in a petrol motor-car; one is in the explosions of the engine, and the other in the working of the gears and chains. With regard to the latter a slight noise is inevitable, but it should be the good sweet hum of perfect machinery, in which a constant musical note can be heard, and not the rattle and buzz which, to experienced ears, is the tell-tale of loose workmanship. With regard to the explosions of the engine, however, great care should be taken in estimating the respective values of noise and comparative silence. In this case, unlike the other, absence of noise very probably means loss of power, and it is necessary to assure oneself that the silencing of the engine has not been achieved at the cost of half its power, as is the case with some cars upon the silence of which the makers greatly value themselves. Provided there is a sufficient margin of power available to run the car at a proper speed and also to climb hills with plenty of life, silence is altogether a benefit; but the buyer must be quite sure that he is not paying for horse-power and petrol consumption, half of which are absorbed by the silencing devices, and which cause his car, lively enough, perhaps, on the level or on a slight downward slope, to become sluggish and lifeless when climbing even a slight hill. He should be particularly on his guard in cases where the silence is attained by the gradual opening and closing of the valves by means of cams shaped like an eccentric. To develop the full power of an engine it is necessary that the valves should, at a certain portion of the stroke, be opened suddenly and fully, and at another point closed equally suddenly and completely. With eccentric cams the opening and closing process is gradual, and

is going on almost continuously throughout the revolution of the cam shaft, with the result that the engine is not getting its full impulse or relief at the exact moments at which these are required for the development of the full power.

Motorists who live in a very hilly or mountainous district will find good steam cars far faster and more satisfactory than petrol cars of corresponding horse-power. Those who wish to use their cars much in town as well as in the country should avoid cars either of very high horse-power or long wheel base. An exceptionally long wheel base, excellent though it is for long-distance touring cars, is a nuisance where much turning is necessary, or where sharp corners and dense traffic are encountered; and there are few more irritating experiences than to drive a 60 h.p. car, say, from Regent Street to Queen's Gate, where the pace is necessarily very slow, and the mighty engine is fretting and heating itself with impatience, and the clutch is continually being thrown in and out.

Plenty of luggage accommodation is more than a convenience in touring cars; it is a necessity. With such a car as the 18 h.p. Lanchester one could go on a tour for months and carry with one practically all necessaries and not a few luxuries. For touring work it is most advisable to have a car with a roof and a certain amount of protection from rain and dust; the passengers in the tonneau of a totally unprotected car look neither very pretty nor very happy after a long journey on a dusty summer's day. Some cars are worse in this respect than others; and if a quite open car is used it should be fitted with a body the back of which is high enough to reach the necks of the occupants; otherwise they will arrive at their destination covered with dust and in a filthy condition. When a cover is used it should have a removable glass screen in front and, for preference, only the back half of the tonneau should be screened with glass. This arrangement, while it protects absolutely from dust and wind, allows a constant stream of fresh air to fill the carriage; in case of rain, light side curtains of waterproof material afford all the additional protection required. Such a carriage should have a roof strong enough to carry a luggage basket and a reasonable amount of luggage.

There is, however, another way of getting rid of the dust nuisance—at any rate, so far as it affects the occupants of the

car—than by a heavy covered-in body to the carriage. I believe the use of this device as a dust-preventer was discovered by Sir Horace Plunkett; at any rate, I had never heard of it before I saw it in use on his car; and I think he discovered it quite accidentally. It consists of nothing more than the ordinary framed glass screen, standing about twenty-five inches above the dashboard. The effect of this is to keep the occupants of the tonneau absolutely free from the distressing clouds of dust that would otherwise come in from behind. This inrush of dust is, of course, caused by the inrush of air to take the place of that displaced by the car in its passage; and it renders a seat in an ordinary tonneau an exceedingly filthy and disagreeable situation on a dusty day. I imagine that the height of the screen is important, as I have not noticed any particular freedom from dust on cars having a high glass screen in front up to a canopy. The following are the dimensions of the arrangement as it is fitted to Sir Horace Plunkett's 10 h.p. Panhard:—

Height from footboard to top of screen	$41\frac{1}{4}$	inches.
Breadth of screen	$39\frac{3}{4}$	"
Height of seat above footboard	19	"
Distance from front of seat to screen	33	"
Distance from back of seat to screen	49	"
Distance from back of front seat to back of tonneau	34	"

These dimensions have, no doubt, an important bearing on the prevention of dust. I take it that what happens is that as the car is travelling a current of air is displaced by the screen and, forced above it, meets in its descent the cloud of dust which comes up behind and blows it back off the tonneau. Of course I am aware that the car travels and not the air; but assuming, for the sake of argument, that the car is standing still, and that a wind is blowing against it from the front at the rate of eighteen or twenty miles an hour, the direction of the wind on striking the screen is upwards. On arriving at the top of the screen and meeting with the free horizontal stream of wind, the direction of the upward-flowing current of wind is deflected slightly downwards again; it then slants towards the back of the tonneau, where it meets the cloud of dust which tends to flow

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into the car behind. Whatever the correct technical explanation of the phenomenon may be, however, it is perfectly successful in practice. I remember once when I was staying with Sir Horace Plunkett making one of a small motoring party one dusty summer afternoon. There were two cars of very similar build and dimensions, and I had the misfortune to occupy a seat, not in Sir Horace's car, but in the tonneau of the other car which had not any glass screen fitting. The result was that when we had gone thirty miles I and my companion in misery were covered with white dust; our hair was full of it and our faces were coated with it. Yet the occupants of the tonneau of Sir Horace's car were perfectly clean and free from dust, and the back of the car—while ours was as white as though a bag of flour had been shaken over it—was speckless and shining in all the glory of Panhard red.

I have only one other thing to say with regard to the ordinary tonneau, as it is fitted on all but the largest cars, and that is that it is an abomination. In all but very large cars the door takes up the best position, and the two seats on either side are cramped and uncomfortable, giving a seated position that is neither forward nor sideways. The back seat of a motor-car should be broad, and cross the whole width of the car, and it should have a high back. The only rational way to secure these advantages is to have a car fitted with side doors and some form of phaeton body. In this way the full space is available for seating accommodation, and the car can be entered from the doorstep or from the kerbstone, and it is not necessary to step into a muddy road and climb in like a monkey at the back of the tonneau.

A LIST OF MOTOR-CARS OF 1904, WITH PARTICULARS OF PRICE, POWER, ETC.

CARS UNDER £200

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
$2\frac{3}{4}$	Sunbeam Mabley	1	1,800	Belt & Chain	2	2	$4\frac{1}{2}$ cwts.	120	John Marston, Ltd., Wolverhampton.
3–6	Waverley (electric)	24	to 15 m.p.h.			2		199 10/-	Locomobile Co., Sussex Place, South Kensington.
$3\frac{1}{2}$	New Orleans	1	850	Belt	2	2	6 cwts.	80	New Orleans Motor Co., Twickenham.
$4\frac{1}{2}$	Eagle Carrier	1		Chain	2	1	$4\frac{1}{2}$ cwts.	125	Eagle Engineering & Motor Co., Altrincham.
$4\frac{1}{2}$	Eagle Tandem	1		Chain	2	2	$5\frac{1}{2}$ cwts.	150	Eagle Engineering & Motor Co., Altrincham.
5	Runabout	1		Chain	2	1	$3\frac{1}{2}$ cwts.	100	Eagle Engineering & Motor Co., Altrincham.
5	Locomobile Standard No. 2	2	Steam	Chain	Variable	2	8 cwts.	190	Locomobile Co., Sussex Place, South Kensington.
5	Oldsmobile	1	700	Chain	2 and rev.	2	7 cwts.	150	Jarrott & Letts, 45, Gt. Marlborough Street, W.
5	Humberette	1	1,500	Gear	2	2	6 cwts.	147	Humber, Ltd., Beeston, Notts.
	Elswick	1	1,500	Gear	3	2	8 cwts.	141 15/-	Elswick Motors, Ltd., Newcastle-on-Tyne.
6	Regal	1	1,600	Gear	2	2	7 cwts.	141 15/-	O. C. Selbach, 66, Great Russell Street, W.C.
6	Mieusset	1	1,000	Chain	3	2	9 cwts.	165	Farman Automobile Co., 100–104, Long Acre, W.C.
6	Eagle Tandem	1		Chain	2	2	$6\frac{1}{2}$ cwts.	160	Eagle Engineering & Motor Co., Altrincham.
6	Mohawk	1	1,500	Gear	2	2	8 cwts.	157 10/-	Mohawk Co., Chalk Farm Road, London.
6	De Dion-Bouton	1	1,700	Gear	2	2 or 3	8 cwts.	200	De Dion-Bouton, 10, Gt. Marlborough Street, W.
6	Brushmobile	1	900	Chain	2	2	5 cwts.	150	Brush Electrical Eng. Co., Belvedere Road, S.E.
6	Vauxhall Light Car	1	900	Chain	2 and rev.	2 or 3	6 cwts.	150	Vauxhall Ironworks Co., Wandsworth Road, S.W.
6	Speedwell Light Car	1	1,000	Gear	3	2	9 cwts.	131 5/-	Speedwell Motor Co., 151, Knightsbridge, S.W.
6	Speedwell Light Car (A)	1	1,000	Gear	4	2	10 cwts.	162 15/-	Speedwell Motor Co., 151, Knightsbridge, S.W.
6	Belsize Junior	1	7 h.p. at 1,000	Chain	3 and rev.	2	$6\frac{1}{2}$ cwts.	175	Belsize Motor Co., Clayton Lane, Manchester.
6	Vulcan	1	1,000	Gear	3 and rev.	2	5 cwts.	105	Vulcan Motor Co., Howe's Side Street, Southport.
6	Star	1	950	Chain	3 and rev.	2	7 cwts. (about)	175	Star Engineering Co., Wolverhampton.
6	Brown	1	1,200	Chain	3 and rev.	2		175	Brown Bros., Great Eastern Street, E.C.
6	Firefly Voiturette	1		Gear	3	2		150–165	Firefly Motor Co., 72, High Street, Croydon.
	Firefly (6 cwts.) Van	1		Gear	3	2		150	Firefly Motor Co., 72, High Street, Croydon.
6	Siddeley Light Car	1	800	Chain	3	3	9 cwts.	175	Siddeley Autocar Co., 79–80, York Street, S.W.
6	Wolseley Voiturette	1	800	Chain	3 and rev.	2		175	The Wolseley Co., Adderley Park, Birmingham.
$6\frac{1}{2}$	Cadillac Runabout	1	800	Chain	2	2	11 cwts.	183 15/-	Anglo-American Co., 19 and 21, Heddon Street, W.
$6\frac{1}{2}$	Richardson	1	1,000	Gear	3	2	7 cwts.	190	J. R. Richardson & Co., Saxilby, near Lincoln.
$6\frac{1}{2}$	B. and L. Car	1		Gear	3	2 or 3	9 cwts.	157 10/-	S. R. Bailey & Lambert, 217, Piccadilly, W.

(A).—The 6 h.p. Speedwell with three seats is sold at £168; with four seats at £178 10s.; and the 9 h.p. is sold with three seats at £189, and four seats at £199 10s.

CARS UNDER £200—(*continued*)

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
6½	Royal Humberette	1	1,500	Gear	3	2	7 cwts.	167	Humber, Ltd., Beeston, Notts.
7	Swift Light Car	1	1,800	Gear	3	2	9 cwts.	200	The Swift Motor Co., Coventry.
8	Darracq	1	1,500	Gear	3 and rev.	4	12 cwts.	195	A. Darracq & Co., 483, Oxford Street, W.
8	Utile-Simplex	1	1,800	Gear	2	4		150	Utile Motor Mfg. Co., Station Av., Kew Gardens.
8	Regal	1	1,500	Gear	3	2 or 4	10 cwts.	178 10/-	O. C. Selbach, 66, Great Russell Street, W.C.
9	Eagle Tandem	1		Chain	2	2	7 cwts.	170	Eagle Engineering & Motor Co., Altrincham.
9	Speedwell Light Car	1	1,000	Gear	4	2	11 cwts.	183 15/-	Speedwell Motor Co., 151, Knightsbridge, S.W.
10	Vulcan	2	1,200	Gear	3 and rev.	2	10 cwts.	200	Vulcan Motor Co., Howe's Side Street, Southport.

CARS OVER £200 AND NOT EXCEEDING £350

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
	Elswick	2	1,200	Gear	4	4	12 cwts.	225	Elswick Motors, Ltd., Newcastle-on-Tyne.
3–6	Waverley Surrey (electric)		40 cells, 80 volts		up to 15 m.p.h.	4		320	Locomobile Co., Sussex Place, South Kensington.
3–6	Waverley Stanhope (electric)		30 cells, 60 volts		up to 15 m.p.h.	2		300	Locomobile Co., Sussex Place, South Kensington.
3–6	Waverley Chelsea (electric)		30 cells, 60 volts		up to 15 m.p.h.	2		250	Locomobile Co., Sussex Place, South Kensington.
3–6	Waverley Physician's Car (electric)		24 cells, 48 volts		up to 15 m.p.h.	2		240	Locomobile Co., Sussex Place, South Kensington.
5	Roots Oil Motor Car (B)	1	750	Gear	3	2 or 3	10 cwts.	220	Roots Motor Co., Chicheley Street, S.E.
6–12	Waverley Delivery Waggon (electric)		40 cells, 80 volts		up to 12 m.p.h.			320	Locomobile Co., Sussex Place, South Kensington.
6½	Clément	1	1,400	Gear	3	4	13½ cwts.	210	E. H. Lancaster, 3, Leicester Street, W.C.
6½	Cadillac Tonneau	1	800	Chain	2	4	11·75 cwts.	210	Anglo-American Co., 19 and 21, Heddon St., W.
6½	Cadillac Delivery Van (C)	1	800	Chain	2	2	12·25 cwts.	210	Anglo-American Co., 19 and 21, Heddon St., W.
	Baker Electric Runabout			Chain	3	2	650 lbs.	204 15/-	Anglo-American Co., 19 and 21, Heddon St., W.
	Baker Imperial			Chain	3	2	750 lbs.	283 10/-	Anglo-American Co., 19 and 21, Heddon St., W.
7	Daimler	2	720	Chain	3	4	15 cwts. (about)	300	The Daimler Motor Co., Coventry.
7	Panhard and Levassor (D)	2		Chain	4	4		340	C. S. Rolls & Co., Lillie Hall, S.W.
7	Star	2	900	Chain	3	4	14 cwts. (about)	320	Star Engineering Co., Wolverhampton.
7	Renault	1		Gear	3	4		270	Lemaire & Thackthwaite, 7, Maddox Street, W.

(B).—The Roots 5 h.p. engine is horizontal, the power stated is developed at 750 r.p.m., but engine may run up to 900. The price given is for the car fitted with solid tyres. The chassis is also supplied with bodies and wheels suitable for agricultural purposes, for ploughing, threshing, chaff-cutting, etc., and, by detaching a pulley, for self-propelling or tractor purposes.

(C).—Space for goods, 3 ft. 6 in. × 2 ft. 11 in. × 3 ft. 2 in.

(D).—The Panhard prices given by different firms will be found to vary. In some cases the discrepancy is explained by the car being priced complete with body, or else for chassis only, or chassis without tyres.

7	M.M.C.	2	720	Chain	3	4	17 cwts.	300	Motor Mfg. Co., 95, New Bond Street, W.
7	Panhard and Levassor (chassis)	2		Chain	4			305	J. E. Hutton, Ltd., 81-83, Shaftesbury Avenue, W.
7	Panhard and Levassor (chassis without tyres)	2		Chain	4			250	Brit. Auto. Com. Synd., Long Acre, W.C.
7	Locomobile Runabout	2	Steam	Chain	Variable	4	11 cwts.	300	Locomobile Co., Sussex Place, South Kensington.
7	Locomobile Light Surrey No. 5	2	Steam	Chain	Variable	2	10 cwts.	210	Locomobile Co., Sussex Place, South Kensington.
7	Renault	1		Gear	3	4	13 cwts.	320	RoadwayAuto-car Co., Newman St., Oxford St., W.
8	Brown	2	850	Chain	3	4		315	Brown Bros., Great Eastern Street, E.C.
8	Brown	2	900	Gear	3	4		285	Brown Bros., Great Eastern Street, E.C.
8	Wolseley Tonneau	2	900	Chain	3	4		330	The Wolseley Co., Birmingham.
8	M.M.C. (automatic inlet valve)	1	1,400	Chain	3	4	10 cwts.	255	Motor Mfg. Co., 95, New Bond Street, W.
8	M.M.C. (m.o.v.)	1	1,450	Chain	3	4	10 cwts.	285	Motor Mfg. Co., 95, New Bond Str eet, W.
8	Georges-Richard Brazier	2	1,200	Gear	3	4	10¼ cwts.	300	Mann & Overton, 7a, Lower Belgrave Street, S.W.
8	Talbot	2	1,000	Gear	3	4	11 cwts.	275	Brit. Auto. Com. Synd., Long Acre, W.C.
8	De Dion-Bouton	1	1,600	Gear	3	4	12 cwts.	285	De Dion-Bouton, 10, Gt. Marlborough Street, W.
8½	Humber	2	1,000	Gear	3	4	12 cwts.	262 10/-	Humber, Ltd., Beeston, Notts.
9	Beaufort Tonneau	1	900	Gear	3	2	11 cwts.	299 5/-	Beaufort Motor Co., 14, Baker Street, London, W.
9	Beaufort Phaeton	1	900	Gear	3	2	11 cwts.	220 10/-	Beaufort Motor Co., 14, Baker Street, W.
9	Mathien	1	1,000	Gear	3	4	12 cwts.	260	L. A. Beckett, 81, King William Street, E.C.
9	Darracq	2	1,400	Gear	3	4	13 cwts.	255	A. Darracq & Co., 483, Oxford Street, W.
9	Swift	2	900	Gear	3	4	11½ cwts.	350	The Swift Motor Co., Coventry.
9	Dennis	1	1,400	Gear	3	4	11 cwts.	280	Dennis Bros., Guildford, Surrey.
	Firefly (12 cwts.) Van	1		Gear	3	2		250	Firefly Motor Co., 72, High Street, Croydon.
9	Peugeot	2	1,200	Gear	3	4	13½ cwts.	325	Siddeley Autocar Co., 79–80, York Street, S.W.
9	Clément	2	1,200	Gear	3	4	12¾ cwts.	350	E. H. Lancaster, 3, Leicester Street, W.C.
9	Eagle Light Car	1		Gear	2	2	13 cwts.	235	Eagle Engineering & Motor Co., Altrincham.
9	New Orleans	2	900	Gear	3	4	11 cwts.	294	New Orleans Motor Co., Twickenham.
9	Argyll	1	1,500	Gear	3	4	12 cwts.	275	Hozier Eng. Co., Bridgeton, Glasgow.
10	Minerva	2	1,200	Chain	3	4		250	Minerva Motors, Ltd., 40, Holborn Viaduct. E.C.
10	Pick	2	1,500	Chain	3	4	15 cwts.	304 10/-	Pick Motor Co., Blackfriars Works, Stamford.
10	Speedwell Light Car	2	900	Gear	4	4	18 cwts.	236 5/-	Speedwell Motor Co., 151, Knightsbridge, S.W.
10	Duryea Phaetonette (E)	3	700	Chain	2	2	8 cwts.	250	The Duryea Co., Coventry.
10	Vulcan	2	1,200	Gear	3	4 or 5	12½ cwts.	275	Vulcan Motor Co., Howe's Side Street, Southport.
10	Albany Silent Safety Car	1	1,000	Gear	3	2	12 cwts.	262 10/-	Albany Mfg. Co., Willesden Junction, N.W.
10	Simms-Welbeck	2	1,250	Gear	3	4	15 cwts.	380	The Simms Mfg. Co., Kimberley Road, N.W.
10	Argyll	2	1,300	Gear	3	4	11 cwts	350	Farman Automobile Co., 100–104, Long Acre, W.C.
10	Pick	2	1,000	Chain	3	4	15 cwts.	304 10/-	The Pick Motor Co., Stamford.
10	Argyll	2	1,100	Gear	3	4	16 cwts.	350	Hozier Eng. Co., Bridgeton, Glasgow.
10	Locomobile Stanhope	2	Steam	Chain	Variable	2	10 cwts.	330	Locomobile Co., Sussex Place, South Kensington.
10	Heron	2		Gear	3	4	18 cwts.	300	J. J. Horne, Moseley, Birmingham.
11	Talbot	2	1,000	Gear	3	4	11½ cwts.	350	Brit. Auto. Com. Synd., Long Acre, W.C.
12	Mohawk	2	1,500	Gear	3	4	12 cwts	300	Mohawk Co., Chalk Farm Road, London.
12	Phœnix	2		Gear	3	4		350	Phœnix Motor Co., Southport.
12	Drummond	2	700	Gear	3	4	19 cwts.	340	Dumfries Brass and Iron Foundry, Dumfries.
12	Duryea Phaetonette	3	600	Chain	2	2	11½ cwts.	300	The Duryea Co., Coventry.
12	Darracq	2	1,200	Gear	3	5	15 cwts.	350	A. Darracq & Co., 483, Oxford Street, W.

(E).—The 10 h.p. is fitted with other bodies. Phaeton with two seats, weight 9 cwt., at £295; Rumble Phaeton, three seats, 9½ cwt., £325; Folding Front Phaeton, four seats, 10 cwt., £325; Dogcart, four seats, 10 cwt., £335.

CARS OVER £200 AND NOT EXCEEDING £350—*(continued)*

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
12	Simms-Welbeck	2	1,500	Gear	3	4	15½ cwts.	335	The Simms Mfg. Co., Kimberley Road, N.W.
12	Chenard and Walcker Voiture Légere	2	1,200	Chain	3	4	18½ cwts. (about)	400	The Weston Motor Syndicate, 14, Mortimer St., W.
12	Durkopp	2	900	Chain	3	4	18¾ cwts.	350	Motor Car Emporium, 1, Addison Road North, W.
12	Herald	2	900	Chain	3	4	14 cwts.	350	S. R. Bailey & Lambert, 217, Piccadilly, W.
12	Regal	2	1,200	Gear	3	5	13 cwts.	262 10/-	O. C. Selbach, 66, Great Russell Street, W.C.
12	Eagle Tonneau	2	950	Gear	2	4	16½ cwts.	310	Eagle Engineering & Motor Co., Altrincham.
12	Tyne	2	1,500	Gear	3	4	12 cwts.	275	W. Galloway & Co., Gateshead-on-Tyne.
12	Heron	2		Gear	3	5	16 cwts.	325	J. J. Horne, Moseley, Birmingham.
15	Minerva	3	1,200	Chain	3	5		340	Minerva Motors, Ltd., 40, Holborn Viaduct, E.C.

CARS OVER £350 AND NOT EXCEEDING £500

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
6–12	Waverley Brougham (electric)		40 cells, 80 volts		up to 15 m.p.h.	4		395	Locomobile Co., Sussex Place, South Kensington.
	Waverley Special (electric)		48 cells, Edison battery, 60 volts		up to 16 m.p.h.	2		490	Locomobile Co., Sussex Place, South Kensington.
7	Panhard	2		Chain	2	4		300	Lemaire & Thackthwaite, 7, Maddox Street, W.
8	Panhard and Levassor	3		Chain	4	4		465	C. S. Rolls & Co., Lillie Hall, Fulham.
8	Panhard and Levassor (chassis)	3		Gear	4			425	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
8	Panhard and Levassor (chassis without tyres)	3		Chain	4			348	Brit. Auto. Com. Synd., Long Acre, W.C.
9	Gardner-Serpollet Steam	4	700	Chain		4	15 cwts.	400	Speedwell Motor Co., 151, Knightsbridge, S.W.
9	Gladiator	2	1,200	Chain	3 or 4	2 or 4	13½ cwts.	350–360	S. F. Edge, 14, New Burlington Street, W.
9	James and Browne Standard Tonneau	2	700	Chain	4	4	17 cwts.	382–400	James & Browne, 395, Oxford Street, W.
9	James and Browne Light Covered Van	2	700	Chain	4		18 cwts.	360	James & Browne, 395, Oxford Street, W.
10	Miesse Steam	3	1,000	Chain		4 or 5	19 cwts.	430 10/-	Turner's Motor Mfg. Co., Wolverhampton.
10	Beaufort Tonneau	2	850	Gear	3	4	14½ cwts.	396 18/-	Beaufort Motor Co., 14, Baker Street, London, W.
10	Decauville	2	1,000	Gear	4 and rev.	4	16 cwts.	360	The Motor Car Co., 168, Shaftesbury Avenue, W.C.
	Baker Stanhope			Chain	3	2	950 lbs.	367 10/-	Anglo-American Co., 19 and 21, Heddon St., W.
10	Duryea Coupé (F)	3	700	Chain	2	2	11½ cwts.	360	The Duryea Co., Coventry.
10	White Steam Car (G)	2	800	Gear	up to 40 m.p.h.	4	1,500 lbs.	420	White Steam Cars, 35–37, King Street, W.

(F).—These cars are all driven by single chain from two-speed gear drum driving direct on top speed.
(G).—White Steam Car transmission is through live axle, and universal joints to sun and planet gear. The price of chassis is £375, and the car fitted with limousine body, £475.

10	Ryknield Tonneau . . .	2	1,000	Gear	3	4	15 cwts.	367 10/-	Ryknield Engine Co., Burton-on-Trent.
10	Ryknield Station Luggage Cart . .	2	1,000	Gear	3	2	14½ cwts.	335	Ryknield Engine Co., Burton.on-Trent.
10	Ryknield Light Delivery Van . .	2	1,000	Gear	2	2	20 cwts.	340	Ryknield Engine Co., Burton-on-Trent.
10	Renault	2		Gear	2	4		380	Lemaire & Thackthwaite, 7, Maddox Street, W.
10	Thornycroft Car . . .	2	900	Gear	3	4 or 5	16 cwts.	440	The Thornycroft Steam Waggon Co., W.
10	M.M.C.	2	1,050	Chain	3	4	17 cwts.	395	Motor Mfg. Co., 95, New Bond Street, W.
10	Panhard and Levassor (chassis) . .	4		Gear	4			490	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
10	Panhard and Levassor (chassis without tyres)	4		Chain	4			448	Brit. Auto. Com. Synd., Long Acre, W.C.
10	De Dion-Bouton . . .	2	1,500	Gear	3	4	14 cwts.	385	De Dion-Bouton, 10, Gt. Marlborough Street, W.
10	Locomobile Dos-a-Dos . . .	2	Steam	Chain	Variable	4	12 cwts.	400	Locomobile Co., Sussex Place, South Kensington.
10	Locomobile Surrey . . .	2	Steam	Chain	Variable	4	12 cwts.	410	Locomobile Co., Sussex Place, South Kensington.
10	Renault	2	1,500	Gear	3	4	15 cwts.	410	Roadway Auto. Co., Newman St., Oxford St., W.
10	Norfolk	2	800	Chain	3	4	15 cwts.	385	Cooke & Wade, Cutlers' Hall, Sheffield.
10	Lanchester Touring Car . . .	2	700	Gear	3	4	19¾ cwts.	500	Lanchester Engine Co., Sparkbrook, Birmingham.
10	Brushmobile . . .	2	850–900	Chain	3	4	14 cwts.	400	Brush Electrical Eng. Co., Belvedere Road, S.E.
12	Beaufort Princess Car . . .	2	850	Gear	3 and rev.	5	15¼ cwts.	448 7/-	Beaufort Motor Co., 14, Baker Street, London, W.
12	Richardson	2	900	Gear	4	4	17 cwts.	367 10/-	J. R. Richardson & Co., Saxilby, near Lincoln.
12	Brooke	3	900	Chain	3	4 or 5	19 cwts.	450	J. W. Brookes & Co., Adrian Works, Lowestoft.
12	Brooke Light Car . . .	3	900	Chain	3	4	16 cwts.	450	J. W. Brookes & Co., Adrian Works, Lowestoft
12	Korte	2	1,400	Chain	4	4	19 cwts.	400	Rice & Co. (Leeds), Ltd.
12	Star	4	900	Chain	4	4	17 cwts. (about)	500	Star Engineering Co., Wolverhampton.
12	Light Star	4	900	Chain	3	4	15 cwts. (about)	420	Star Engineering Co., Wolverhampton.
12	Brown	4	900	Chain	4	4		500	Brown Bros., Great Eastern St., E.C.
12	Wolseley Tonneau . . .	2	800	Chain	4	4		400	The Wolseley Co., Adderley Park, Birmingham.
12	Pipe	4	900	Chain	4	5	16 cwts.	390	The London Motor Garage, 33–37, Wardour St., W.
12	Albion	2	200 to 950	Chain	3	4	21½ cwts.	400	Albion Motor Car Co., Scotstoun, Glasgow, W.
12	Rex Simplex	2	1,000	Gear	3	5	16 cwts.	383 5/-	Rex Motor Manufacturing Co., Coventry.
12	Siddeley Car	2	850	Chain	4	5	16½ cwts.	450	Siddeley Autocar Co., 79–80, York Street.
12	Georges-Richard Brazier . . .	2	1,200	Gear	4	4	12¾ cwts.	400	Mann & Overton, 7a, Lower Belgrave Street, S.W.
12	Argyll	3	1,300	Gear	4	4	14 cwts.	425	Farman Automobile Co., 100–104, Long Acre, W.C.
12	New Orleans	4	900	Gear	3	4	16 cwts.	398	New Orleans Motor Co., Twickenham.
12	De Dion-Bouton	2	1,500	Gear	3	4	16 cwts.	445	De Dion-Bouton, 10, Gt. Marlborough Street, W.
12	Argyll	3	1,100	Gear	3	4	16 cwts.	425	Hozier Engineering Co., Bridgeton, Glasgow.
12	Gladiator	2	1,200	Chain	3 or 4	4	14 cwts.	395	S. F. Edge, 14, New Burlington Street, W.
12	Norfolk	2	800	Chain	3	4	15 cwts.	395	Cooke & Wade, Cutlers' Hall, Sheffield.
12	Cremorne Steam Car . . .	4	400	Chain	1	5	19¾ cwts.	500	Cremorne Motor Mfg. Co., Lots Rd., Chelsea, S.W.
12–14	Dennis One Ton Van . . .	2	800	Gear	3		25 cwts.	451 10/-	Dennis Bros., Guildford, Surrey.
	Firefly (20 to 25 cwts.) Van . .	2		Gear	3	2		400	Firefly Motor Co., 72, High Street, Croydon.
	Firefly (40 cwts.) Van . . .	4		Gear	4	2		500	Firefly Motor Co., 72, High Street, Croydon.
12–14	Dennis	2	800	Gear	3	4	16 cwts.	420	Dennis Bros., Guildford, Surrey.
12–14	Brooke	3		Chain	3		17 cwts.	450	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
12–15	Standard Double Phaeton . . .	2	1,200	Gear	4	4	15 cwts.	367 10/-	Standard Motor Co., 128, Much Park St., Coventry.
14	Brushmobile	4	900	Chain	3	4	17 cwts.	500	Brush Electrical Eng. Co., Belvedere Road, S.E.
15	Duryea Surrey	3	750	Chain	2	4	15 cwts.	400	The Duryea Co., Coventry.
15	Darracq	4	1,000	Gear	3	5	17 cwts.	460	A. Darracq & Co., 483, Oxford Street, W.
15–19	Ariel	4	1,450	Gear	4	4	17 cwts.	495	Ariel Motor Co., Birmingham.

CARS OVER £350 AND NOT EXCEEDING £500—(*continued*)

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
15–20	Belsize	3	19 h.p. at 900	Gear	3	5	18 cwts.	495	Belsize Motor Co., Clayton Lane, Manchester.
16	Heron	4		Gear	3		20 cwts.	450	J. J. Horne, Moseley, Birmingham.
20	Minerva	4	1,200	Chain	3	5		400	Minerva Motors, Ltd., 40 Holborn Viaduct, E.C.
	Elswick	4	1,000	Chain	4	To order	16 cwts.	450	Elswick Motors, Ltd., Newcastle-on-Tyne.
25	Straker Steam Delivery Van	2	500	Chain			Load 2 tons	500	Straker Steam Vehicle Co., Ltd., 9, Bush Lane, E.C.

CARS OVER £500 AND NOT EXCEEDING £700

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
9½	Milnes-Daimler Lorry (to carry 2½ tons)	2	1,000	Gear	4	2		550	The Elsworth Co., Manningham Lane, Bradford.
10	Clément (H)	4	1,000	Gear	4		14¾ cwts.	650	E. H. Lancaster, 3, Leicester Street, W.C.
10	Gardner-Serpollet Steam	4	700	Chain		4	18 cwts.	550	Speedwell Motor Co., 151, Knightsbridge, S.W.
10	Panhard and Levassor	4		Both	4	4		540	C. S. Rolls & Co., Lillie Hall, Fulham, S.W.
10	Panhard	4		Chain	4	4		550	Lemaire & Thackthwaite, 7, Maddox Street, W.
12	Clément	4	1,000	Gear	4	4	15½ cwts.	550	E. H. Lancaster, 3, Leicester Street, W.C.
12	Roots Oil Motor Car (I)	2	750	Gear	4	4, 6, or 8	1 ton (about)	640	The Roots Motor Co., Chicheley Street, S.W.
12	Milnes-Daimler Lorry (to carry 3 tons)	2	1,000	Gear	4	2		585	The Elsworth Co., Manningham Lane, Bradford.
12	James and Browne Tonneau	4	800	Chain	4	4	17½ cwts.	525	James & Browne, 395, Oxford Street, W.
12	James and Browne Landaulet (K)	4	800	Chain	4	4	18 cwts.	600	James & Browne, 395, Oxford Street, W.
12	De Dietrich (Turcat-Mery)	4	800	Chain	4	5	18 cwts.	650	Burlington Carriage Co., 315–317, Oxford Street.
12	Mors	4	1,000	Chain	4	4	17 cwts.	570	Roadway Autocar Co., Newman St., Oxford St., W.
12	Lanchester Touring Car	2	700	Gear	3	4	20¾ cwts.	550	Lanchester Engine Co., Sparkbrook, Birmingham.
12	Sunbeam	4	1,000	Chain	4	4	16 cwts.	512	John Marston, Wolverhampton.
12	Decauville	4	900	Gear	3 and rev.	4	16½ cwts.	550	The Motor Car Co., 168, Shaftesbury Avenue, WC.
12–15	De Dietrich	4	700	Chain	4	4	17 cwts. (about)	650	Jarrott & Letts, 45, Gt. Marlborough Street, W.
12–16	Spyker	4	1,000	Gear	3	4	18 cwts.	510	The Elsworth Co., Manningham Lane, Bradford.
	Elswick	4	820	Chain	4	To order	19½ cwts.	650	Elswick Motors, Ltd., Newcastle-on-Tyne.
14	Ryde	3	900	Gear	3	4	16 cwts.	550	Ryde Motors, Ltd., Grosvenor Road, W. Ealing.
14	Renault	4		Gear	2	4		600	Lemaire & Thackthwaite, 7, Maddox Street, W.
14	Humber	4	950	Gear	4	4	18 cwts.	603 15/-	Humber, Ltd., Beeston, Notts.
14	Talbot	4	1,000	Gear	4	4	15½ cwts.	585	Brit. Auto. Com. Synd., Long Acre, W.C.
14	Renault	4		Gear	3	4	17 cwts.	680	Roadway Autocar Co., Newman St., Oxford St., W.
14	Gladiator	4	1,200	Chain	4	4	16 cwts.	545	S. F. Edge, 14, New Burlington Street, W.

(H).—Special Landaulette body.
(I).—Roots 12 h.p. engine is vertical; 13 b.h.p. is developed at 750 r.p.m. (See also Note B.)
(K).—The 12 h.p. James & Browne is fitted as Single Brougham at £595; Double Landaulette, £625; Double Brougham, £620.

14	Brushmobile	4	900	Chain	4		17 cwts.	600	Brush Electrical Eng. Co., Belvedere Road, S.E.
14	Decauville	4	900	Gear	3 and rev.	4	18 cwts.	600	The Motor Car Co., 168, Shaftesbury Avenue, W.C.
15	Beaufort Princess	4	750	Chain	3	5	19 cwts.	572·5	Beaufort Motor Co., 14, Baker Street, W.
15	Gardner-Serpollet Steam	4	700	Chain		4	20 cwts.	700	Speedwell Motor Co., 151, Knightsbridge, S.W.
15	Brooke	4	900	Chain	3	4 to 6	17 cwts.	525	J. W. Brooke & Co., Adrian Works, Lowestoft.
15	Panhard and Levassor	4		Both	4	4		675	C. S. Rolls & Co., Lillie Hall, Fulham, S.W.
15	Pipe (L)	4	900	Chain	4	5	18 cwts.	640	London Motor Garage Co., 33–37, Wardour St., W.
15	Beaufort Princess Car	4	750	Gear	3 and rev.	5	18½ cwts.	546	Beaufort Motor Co., 14, Baker Street, London, W.
15	Panhard and Levassor (chassis)	4		Gear	4			630	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
15	Panhard and Levassor (chassis, without tyres)	4		Chain	4			589	Brit. Auto. Com. Synd., Long Acre, W.C.
15	New Orleans	4	900	Gear	4	4 or 5	18 cwts.	561	New Orleans Motor Co., Twickenham.
	Martini (chassis)	4	1,100	Chain	4	5	19 cwts.	620	Deasy & Co., 217, Piccadilly Circus, W.
16	Germain Standard (chassis)	4	850	Chain	4	5	18 cwts.	525	Germain Motor Cars, 1, Hanover Court, W.
16	Daimler (M)	4	800	Chain	4	4 or 5	20 cwts. (about)	650	Daimler Motor Co., Coventry.
16	Milnes-Daimler Lorry (to carry 5 tons)	4	1,000	Gear	4	2		680	The Elsworth Co., Manningham Lane, Bradford.
16	Wolseley Tonneau	4	900	Chain	4	4		550	The Wolseley Co., Adderley Park, Birmingham.
16	Fiat	4	1,000	Chain	4	5	17½ cwts.	695	Fiat Motors, Ltd., 37, Long Acre, W.C.
16	Albany Silent Safety Petro Car	4	800	Chain	4	4	16 cwts.	525	The Albany Mfg. Co., Willesden Junction, N.W.
16	Miesse Steam	3	1,000	Chain		4, 5, or 6	26 cwts.	640 10/-	Turner's Motor Mfg. Co., Wolverhampton.
16	Durkopp	3	900	Chain	3	5	850 kilogs.	550	Motor Car Emporium, 1, Addison Road North, W.
16	Georges-Richard Brazier	4	1,200	Gear	4	4	14 cwts.	550	Mann & Overton, 7a, Lower Belgrave Street, S.W.
16	F.I.A.T. (chassis, with tyres)	4		Chain	4			575	Brit. Auto. Com. Synd., Long Acre, W.C.
16	Mieusset	4	850	Chain	4	5	20 cwts.	650	Farman Automobile Co., 100–104, Long Acre, W.C.
16	Argyll	4	1,100	Gear	3	4	16 cwts.	550	Hozier Engineering Co., Bridgeton, Glasgow.
16	Lanchester Touring Car	2	780	Gear	3	4	19¾ cwts.	660	Lanchester Engine Co., Sparkbrook, Birmingham.
16	Brushmobile	4	900	Chain	4	4	22 cwts.	700	Brush Electrical Eng. Co., Belvedere Road, S.E.
16	Decauville	4	900	Gear	3 and rev.	4	19 cwts.	650	The Motor Car Co., 168, Shaftesbury Avenue, W.C.
16–20	Mathien	4	800	Gear or Chain	4	5	15 cwts.	560	L. A. Beckett, 31, King William Street, E.C.
16–20	Dennis	4	950	Gear	3	4	17½ cwts.	550	Dennis Bros., Guildford, Surrey.
18	Star	4	900	Chain	4	4	18 cwts. (about)	550	Star Engineering Co., Wolverhampton.
18	Siddeley Car	4	1,000	Chain	4	5	17½ cwts.	650	Siddeley Autocar Co., 79–80, York Street, S.W.
18	James and Browne Tonneau	4	700	Chain	4	4	18 cwts.	650	James & Browne, 395, Oxford Street, W.
18	Maudslay Chassis	3	800	Chain	4		18½ cwts.	682 10/-	Maudslay Motor Co., Coventry.
18–22	Ariel (chassis)	4	1,450	Gear	4	5	18 cwts.	555	Ariel Motor Co., Birmingham.
20	Winton Touring Car	2	1,000	Chain	2	5	1,975 lbs.	624 15/-	Anglo-American Co., 19 and 21, Heddon St., W.
20	Ryknield Touring Car	4	1,000	Chain	4	5	20 cwts.	680	Ryknield Engine Co., Burton-on-Trent.
20	Thornycroft Car	4	900	Gear	3	4 or 5	18½ cwts.	660	The Thornycroft Steam Waggon Co., London, W.
20	Dennis	4	950	Gear	3	4 or 5	18½ cwts.	630	Dennis Bros., Guildford, Surrey.
20	M.M.C. (automatic inlet valves)	4	1,100	Chain	3	5	20 cwts.	700	Motor Mfg. Co., 95, New Bond Street, W.
20	Durkopp	4	900	Chain	3	5	875 kilogs.	600	Motor Car Emporium, 1, Addison Road North, W.
20	Talbot	4	1,000	Gear	4	4	16¾ cwts.	680	Brit. Auto. Com. Synd., Long Acre, W.C.
20–24	Simms-Welbeck	4	1,500	Gear	3	4	17 cwts.	600	The Simms Mfg. Co., Ltd., Kimberley Rd., N.W.
20–24	Spyker	4	1,000	Gear	3	4 or 5	19 cwts.	650	The Elsworth Co., Manningham Lane, Bradford.
20–24	Dennis	4	1,100	Gear	3	4 or 5	21 cwts.	650	Dennis Bros., Guildford, Surrey.
20–26	Ariel (chassis)	4	1,250	Gear	4	5	19½ cwts.	675	Ariel Motor Co., Birmingham.
24	Star	4	900	Chain	4	4	22 cwts. (about)	650	Star Engineering Co., Wolverhampton.

(L).—The Pipe cars, of 15, 20, and 30 h.p., are fitted with magneto clutch.
(M).—The 16 h.p. Daimler Chassis is sold separately at £550.

CARS OVER £500 AND NOT EXCEEDING £700—(*continued*)

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
24	Darracq	4	1,000	Gear	3	5	19 cwts.	580	A. Darracq & Co., 483, Oxford Street, W.
24	Wolseley Tonneau	4	800	Chain	4	4		650	The Wolseley Co., Adderley Park, Birmingham.
24	Rex Simplex	4	1,000	Gear	3	5	22 cwts.	682 10/-	Rex Motor Manufacturing Co., Coventry.
24	Wilkinson de Cosmo	4	900	Gear	3	5	19½ cwts.	650	The Cadogan Motor Co., Sydney Street, Chelsea.
24	Durkopp	4	800	Chain	4	6	950 kilogs.	700	Motor Car Emporium, 1, Addison Road North, W.
24	Regal	4	1,000	Gear	4	5	18 cwts.	525	O. C. Selbach, 66, Great Russell Street, W.C.
24	Richardson	4	900	Gear	4	4 or 5	19 cwts.	650	J. R. Richardson & Co., Saxilby, near Lincoln.
24	Eagle Tonneau	4	950	Gear	3	4	18 cwts.	535	Eagle Engineering & Motor Co., Altrincham.
30	Simms-Welbeck	4	1,500	Gear	3	4	17½ cwts.	650	The Simms Mfg. Co., Ltd., Kimberley Rd., N.W.

CARS OVER £700

H.P.	NAME OF CAR.	No. of Cylinders.	Revolutions per minute at which h.p. claimed is developed.	Transmission. Chain or Gear.	No. of Speeds.	No. of Seats.	Weight unladen, with standard type of body.	Price in £ s.	NAME OF FIRM AND ADDRESS.
12-16	Wilson-Pilcher	4	900	Gear	4	5	20 cwts.	735	Sir W. G. Armstrong, Whitworth, & Co., 32, Great Peter Street, Westminster.
14	Mors	4	1,200	Chain	4	4	17½ cwts.	800	Roadway Autocar Co., Newman St., Oxford St., W.
15	Napier (chassis only)	4	1,000	Chain	4	4	15 cwts.	700	S. F. Edge, 14, New Burlington Street, W.
15	Panhard	4		Chain	4	4		2,200	Lemaire & Thackthwaite, 7, Maddox Street, W.
16	De Dietrich (Turcat-Mery)	4	800	Chain	4	5	19½ cwts.	700	Burlington Carriage Co., 315–317, Oxford Street.
16	F.I.A.T.	4	1,500	Chain	4	4	17½ cwts.	750	Farman Automobile Co., 100-104, Long Acre, W.C.
16-22	Rochet-Schneider	4	800	Chain	4	5	18 cwts.	725	Morgan Donne, 27, St. John's Square, Clerkenwell.
16-22	De Dietrich	4	700	Chain	4	4	18 cwts. (about)	760	Jarrott & Letts, 45, Great Marlborough Street, W.
18	Chenard and Walcker Car de Luxe	4	1,200	Gear	3	5	20 cwts. (about)	750	Weston Motor Syndicate, 14, Mortimer Street, W.
18	Daimler (N)	4	800	Chain	4	4, 5, or 6	20 cwts. (about)	750–825	Daimler Motor Co., Coventry.
18	Panhard and Levassor	4		Chain	4	4		800	C. S. Rolls & Co., Lillie Hall, Fulham, S.W.
18	Panhard and Levassor (chassis)	4		Gear	4			750	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
18	Mercédès	4		Gear	4			1,200	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
18	Gladiator	4	1,100	Chain	4	4	17 cwts.	745	S. F. Edge, 14, New Burlington Street, W.
18	Lanchester Touring Car	2	780	Gear	3	5	19½ cwts.	720	Lanchester Engine Co., Sparkbrook, Birmingham.
18	Maudslay Double Phaeton	3	800	Chain	4	4	23 cwts.	818 15/-	Maudslay Motor Co., Coventry.
18	Napier (chassis only)	6	900	Chain	3	4 or 6	19 cwts.	1,050	S. F. Edge, 14, New Burlington Street, W.
18-22	Mercédès	4		Chain	4	4		1,100	Lemaire & Thackthwaite, 7, Maddox Street, W.
18-22	Brushmobile	4	900	Chain	4	4	22 cwts.	750	Brush Electrical Eng. Co., Belvedere Road, S.E.
18-24	Wilson-Pilcher	6	900	Gear	4	5	21 cwts.	892 10/-	Sir W. G. Armstrong, Whitworth, & Co., 32, Great Peter Street, Westminster.

(N).—The 18 h.p. Daimler Chassis is supplied separately at £650 to £700; the 22 h.p. Chassis to £700; and the 28 h.p. Chassis at £850 to £900.

19	Mors	4	1,200	Chain	4		21 cwts.	905	RoadwayAutocarCo.,NewmanSt.,OxfordSt.,W.
20	Clément	4	1,000	Chain	4	4		725	E. H. Lancaster, 3, Leicester Street, W.C.
20	Pipe	4	900	Chain	4	5	20 cwts.	750	London Motor Garage, 33–37, Wardour Street,W.
20	M.M.C. (m.o.v.)	4	1,100	Chain	3	5	20 cwts.	750	Motor Mfg. Co., 95, New Bond Street, W.
20	Napier (chassis only)	4	900	Gear	3	4	19 cwts.	1,200	S. F. Edge, 14, New Burlington Street, W.
22	Crossley	4	800	Chain	4	4	22 cwts.	950	Jarrott & Letts, 45, Great Marlborough Street, W.
22	Daimler	4	720	Chain	4	4 or 5	21 cwts. (about)	750–825	Daimler Motor Co., Coventry.
24	De Dietrich (Turcat-Mery)	4	800	Chain	4	5	22 cwts.	950	Burlington Carriage Co., 315–317, Oxford Street.
24	Léon Bollée	4	750–1,000	Chain	4	4 to 8	19½ cwts.	965	Speedwell Motor Co., 151, Knightsbridge, S.W.
24	Beaufort Tonneau	4	850	Chain	4 and rev.	7	23 cwts.	795 18/-	Beaufort Motor Co., 14, Baker Street, London, W.
24	Germain Standard (chassis)	4	850	Chain	4	5	19 cwts.	740	Germain Motor Cars, 1, Hanover Court, W.
24	Panhard and Levassor	4		Chain	4	4		1,085	C. S. Rolls & Co., Lillie Hall, Fulham, S.W.
24	Fiat	4	1,200	Chain	4 and rev.	5	18¾ cwts.	895	Fiat Motors, Ltd., 37, Long Acre, W.C.
24	Georges-Richards Brazier	4	1,200	Gear	4	4	16 cwts.	770	Mann & Overton, 7a, Lower Belgrave St., S.W.
24	F.I.A.T. (chassis, with tyres)	4		Chain	4			735	Brit. Auto. Com. Synd., Long Acre, W.C.
24	Napier (chassis only)	4	750	Chain	4	Any No.	22½ cwts.	900	S. F. Edge, 14, New Burlington Street, W.
24	Mors	4	1,200	Chain	4	4	23 cwts.	1,005	RoadwayAutocarCo.,NewmanSt.,OxfordSt.,W.
24–28	De Dietrich (Burgatti)	4	750	Chain	4	5	21 cwts.	950	Burlington Carriage Co., 315–317, Oxford Street.
24–28	Mercédès	4		Chain	4	4		1,300	Lemaire & Thackthwaite, 7, Maddox Street, W.
24–28	Mercédès	4		Gear	4			1,350	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
24–30	De Dietrich	4	700	Chain	4	4	19½ cwts. (about)	960	Jarrott & Letts, 45, Great Marlborough Street, W.
24–35	Rochet-Schneider	4	900	Chain	4	6	20 cwts.	940	Morgan Donne, 27, St. John's Square, Clerkenwell.
25	Humber	4	900	Gear	4	5	22 cwts.	840	Humber, Ltd., Beeston, Notts.
25	Maudslay Chassis	3	800	Chain	4		21 cwts.	887 10/-	Maudslay Motor Co., Coventry.
25	Maudslay Waggonette	3	800	Chain	4	8	35 cwts.	1,050	Maudslay Motor Co., Coventry.
27	Talbot	4	1,000	Chain	4	4	19¾ cwts.	920	Brit. Auto. Com. Synd., Long Acre, W.C.
28	Daimler	4	750	Chain	4	5 to 10	24 cwts. (about)	950–1150	Daimler Motor Co., Coventry.
28–30	Dennis	4	1,200	Gear	3 and rev.	5	23 cwts. (about)	750	Dennis Bros., Guildford, Surrey.
28–32	Darracq	4	1,000	Gear	3	5	22 cwts.	750	A. Darracq & Co., 483, Oxford Street, W.
30	Pipe	4	900	Chain	4	5	20 cwts.	1,000	London Motor Garage, 33–37, Wardour Street,W.
30–35	De Dietrich (Burgatti)	4	750	Chain	4	5	25 cwts.	1,100	Burlington Carriage Co., 315–317, Oxford Street.
30–35	Ariel (chassis)	6	1,250	Gear	3	5	21 cwts.	875	Ariel Motor Co., Birmingham.
30–36	Spyker	4	1,000	Gear	3	4 or 5	20 cwts.	800	The Elsworth Co., Manningham Lane, Bradford.
35	Germain Standard (chassis)	4	850	Chain	4	5	20 cwts.	1,100	Germain Motor Cars, 1, Hanover Court, W.
35	Panhard and Levassor	4		Chain	4	4		1,310	C. S. Rolls & Co., Lillie Hall, Fulham, S.W.
35–40	Mercédès	4		Chain	4	4		1,500	Lemaire & Thackthwaite, 7, Maddox Street, W.
35–40	De Dietrich	4	700	Chain	4	4	21 cwts. (about)	1,300	Jarrott & Letts, 45, Great Marlborough Street, W.
38–40	Mercédès	4		Gear	4			1,550	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
40	Léon Bollée	4	750–1,000	Chain	4	4 to 8	22 cwts.	1,450	Speedwell Motor Co., 151, Knightsbridge, S.W.
40	Durkopp	6	750	Chain	2	2	900 kilogs.	1,250	Motor Car Emporium, 1, Addison Road North,W.
40	Maudslay (racing body)	6	800	Chain	4	4	26½ cwts.	1,260	Maudslay Motor Co., Coventry.
60	Spyker	6	1,000	Gear	3	2 or more	under 1,000 kilos.	1,600	The Elsworth Co., Manningham Lane, Bradford.
40	Mercédès			Chain	4	4		1,800	Lemaire & Thackthwaite, 7, Maddox Street, W.
60	Mercédès	4		Chain	4			2,500	J. E. Hutton, 81–83, Shaftesbury Avenue, W.
60	Maudslay (racing body)	6	800	Chain	4	4	27½ cwts.	1,470	Maudslay Motor Co., Coventry.

CHAPTER VIII

LIGHT CARS

The Run-about and its uses—Also its abuses—A hundred miles a day—Imitation of large cars—A case for caution—Difference in principles of construction—The De Dion car—The Oldsmobile—An American invasion—The Belsize car—A celebrated Baby—The Roots paraffin car—The Wolseley light car—The Humber light car.

IN what I said in a previous chapter about motor-cars costing less than £200 I made a distinction between cars for touring purposes and cars suitable for short point-to-point trips on which it is not necessary to carry luggage or supplies. But although I believe it to be impossible at present to buy a satisfactory long-distance touring car for £200, there is, nevertheless, much real pleasure and advantage to be derived from cars of the Run-about type; and there are many of these with engines of 5 or 6 h.p. which cost much less than £200 and will do very satisfactory work under the proper conditions. These conditions are that they should not be overloaded nor overdriven, and that they should be treated tenderly with regard to the road surfaces on which they are travelling. It is just these conditions, however, which are ignored by so many owners of light cars or voiturettes, and it is owing to the neglect of them that so many of these motorists come to grief. Moreover, it cannot be too clearly understood that the sport or hobby of driving these small machines is entirely distinct from that of motoring proper. Neither the possibilities nor the cost of the two things can be compared.

What too often happens is that a beginner purchases a light two-seated motor-car of 4 to 6 h.p. for £200 or less, the unwise manufacturer of which assures him that it is able to "go anywhere and do anything." Pleased with his new possession, and

not over-skilful in the use of it, the motorist begins by setting out on a long journey, at the end of which (if he should attain it without mishap) he is disappointed to find that certain repairs, renewals, and readjustments are required. The need for these may be entirely due to his lack of experience; but that is seldom admitted by the novice, and the car itself is blamed. And even when he has learned to know his little machine thoroughly, he too often contrives to misuse it. Probably he has a back seat fitted, and makes a practice of carrying four people on a machine which was designed and constructed to carry two, and the engine and gearing of which are strained in consequence. He works the car hard, trying to cover distances and take journeys for which a touring car is really needed; he ploughs his wheels through ruts and over stones, and is not over-careful about lubrication or cleaning, with the result that the poor little car has a short life, and its owner becomes disgusted with motoring. "You can't go for a day's run," he says, "without something being needed either on the road or when you get back; always new tyres or gear wheels, or bearings worn, or valves to be ground, or something." He owned a motor-car, you see, and he expected it to do everything that motor-cars are generally supposed to be able to do, quite ignoring the fact that it was a motor-car built for a special limited purpose, which he had much exceeded.

In my opinion the real use for one of these light cars, so far as distance is concerned, is much the same as that to which an expert and trained cyclist would put his bicycle, except that the motor-car makes no demands upon physical endurance. These charming little machines are most happily and profitably used by those who treat them in this way, who do not go out in all weathers or on all kinds of roads, but who choose the day for its weather and the journey for its road. A run of a hundred or a hundred and twenty miles there and back on a summer's day is the most which should be asked of such cars; the traveller is then not too long upon the road to make him tired of it; he has time to attend to the lubrication and replenishment of his machine; he is not worried by the necessity of having to press on at top speed in order to get home before night; and he is not straining his engine by driving it to the limit of its capacity. For such a purpose the small motor-cars,

some of which I am going to describe, are admirably suited; and properly used, they are capable of affording infinite pleasure to their owners.

The number of light cars designed more or less on the lines of high-powered vehicles is legion, but many of them are far from satisfactory examples of motor-car construction. The large and steadily increasing demand for light and inexpensive motor-cars has brought dozens of manufacturers into the market with hastily designed vehicles turned out of imperfectly equipped works, in many cases built up of obsolete component parts which have been discarded by foreign makers. Such cars—often sold at a temptingly low price—lay up a melancholy store of misery, expense, and disappointment for their owners. That they should be thus placed on the market and readily bought is a misfortune inseparable from the early and enthusiastic period of the industry. A similar state of affairs, it will be remembered, was produced by the cycle "boom" in the last decade of the nineteenth century. It is to be hoped that the motor-car industry will soon recover from this undesirable ailment; but it will not be until many a carefully saved little sum has been expended in hopeful expectation and regretted with bitter disappointment. Everything that I have said with regard to the caution that should be used in the purchase of touring cars applies with still greater urgency to the purchase of light cars. There is more temptation to scamp the work in a little car, to construct it of flimsy material and with a complete disproportion of its several parts, than in a large car; and it is easier to construct a light car that will travel in some sort of way than a heavy one. To all English buyers and users of light cars I would strongly recommend the constant study of that admirable little paper, *The Motor*, which makes a special study of light cars and motor-cycles, and is always ready to give its readers honest help and advice.

If you put the unscrupulous assemblers of these light machines entirely out of the question, however, there remains a very great number of types of the light motor-car into the manufacture of which genuine care and honest workmanship are put. Even here, however, there exists an extraordinary difference of opinion and variety of practice as regards essentials. The mere size and speed of different engines giving out a

similar horse-power varies astonishingly. A comparison between the Oldsmobile engine and the De Dion affords a good example of this. Both are 6 h.p. engines, and both have a single cylinder; but the Oldsmobile has a bore of $4\frac{1}{2}$ inches, a stroke of 6 inches, and gives off its maximum power of 760 revolutions per minute; while the De Dion 6 h.p. engine has a bore of $3\frac{17}{32}$ inches and a stroke of $4\frac{11}{32}$ inches, and develops its maximum power at 1,700 revolutions. One maker claims for the slow-speed engine an increased silence and absence of vibration, while the other claims for a high-speed engine an enhanced lightness of construction and a reduction of thrust on the bearings and strain on the transmission. There is as yet no unanimity with regard to this and a great many other questions, and the buyer is left to decide for himself whether in the case of any given type of engine the virtues of its defects or the defects of its virtues are the greater. No light car has been so long nor so well tried as the De Dion-Bouton voiturette; no light car has during the last year or so achieved anything like the popularity of the Oldsmobile; yet the principles upon which the two cars are constructed are diametrically opposed. It is this uncertainty of principle and lack of unanimity as to practice in petrol-motor engineering that is making many students of such matters turn their attention once more to steam, where principles are more or less fixed, and causes and results have a more or less definite and ascertainable relationship.

I will now describe some typical light cars; but if I were to fill three times the space which is at my disposal, I should not exhaust the varieties of light cars which are being offered for sale even by English manufacturers alone. I have endeavoured in making this selection to describe only those machines as to the capabilities and working of which I have definite information; but I do not pretend that they at all represent the whole of what is sound and satisfactory in the manufacture of light motor-cars.

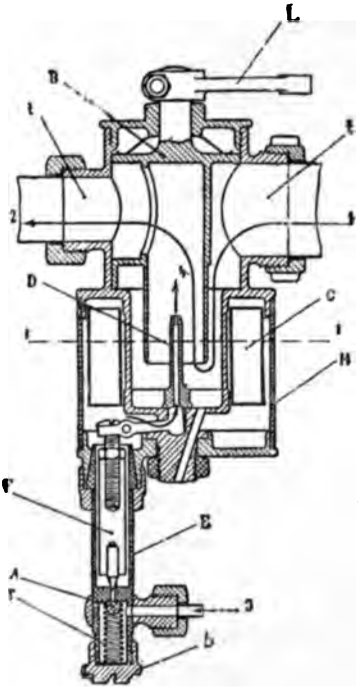
THE DE DION-BOUTON LIGHT CAR

No light motor-car has earned so high a reputation or proved itself during so long a period or through such severe trials as

the De Dion-Bouton car. Since the earliest revivals of the motor industry in France the De Dion Company have been in the field and, in many respects, have led it. Their 6 and 8 h.p. motor-cars are probably, as regards the proportion of power attained with a given weight and bulk of material, the most efficient vehicles in the world. Their system has been to make as small a motor as possible, and to run it at as high a speed as possible, and so obtain the maximum of power with the minimum of weight. Thus their 6 h.p. motor, which has a bore of 90 mm., and weighs, including the fly-wheels, only 132 lbs., gives its normal power at 1,600–1,700 revolutions. By the use of such a motor in the construction of a road vehicle the makers have been able to reduce the strength and weight of frames, springs, wheels, tyres, etc., to a point far below what is possible when heavier engines are used, and this without any risk of reducing the margin of safety which must always be allowed over and above what is mechanically necessary. Another important quality of the De Dion motors is their simplicity of construction; and this, in conjunction with their small size and weight, makes them not only very durable and trustworthy, but also economical in use. Although the De Dion motors are made in several sizes—6, 8, 10, and 12 h.p.—I choose the 6 h.p. car to represent them here, partly because, although the principles of construction employed in all sizes are virtually the same, the 6 h.p. is the simplest of the De Dion cars; and partly also because it is probably the most used and best tried of all their motor-cars.

The single-cylinder engine is placed vertically in front of the weldless steel tube frame under a bonnet, the tubular radiator being carried, not in front of the bonnet, but underneath it. The inlet valve is automatic and is placed over the exhaust valve, which is worked in the usual way by a cam on the half-time shaft. The water-jacket is furnished both with an outlet pipe fixed on the top of the cylinder and with a screw plug at the lowest point of the jacket, so that all water can be drained away. Twin fly-wheels are used, and are enclosed in the crank case, as are also the gearing of the half-time shaft and the shaft itself; the whole mechanism is, indeed, completely enclosed, the only exposed part being the exhaust-valve stem, and spring. A trembling contact breaker, also enclosed, is fitted on the

exhaust-valve side of the engine and is connected with a lever for the purpose of controlling the moment of sparking. The governing and control of the De Dion engine are, in addition, effected through the exhaust valve, a movement being fitted by which its lift can be very finely regulated. By this system the volume of the exhaust can be reduced at will, with the result that the incoming charges of fresh gas are reduced in propor-



A—Fine Gauze Sieve.
b—Cap holding r.
B—Regulating Valve.
C—Float.
D—Spray.
E—Tube enclosing F.
F—Weighted Needle Valve.
G—Balance Lever.
H—Float Chamber.
I I—Level of petrol.
K—Cap of Valve Chamber.
L—Lever working Regulating Valve.
b—Waste Cap.
r—Spring carrying Gauze Sieve A.
t—Air Inlet.
t^1—Mixture Outlet.
1, 2—Direction of air.
3, 4—Direction of petrol.

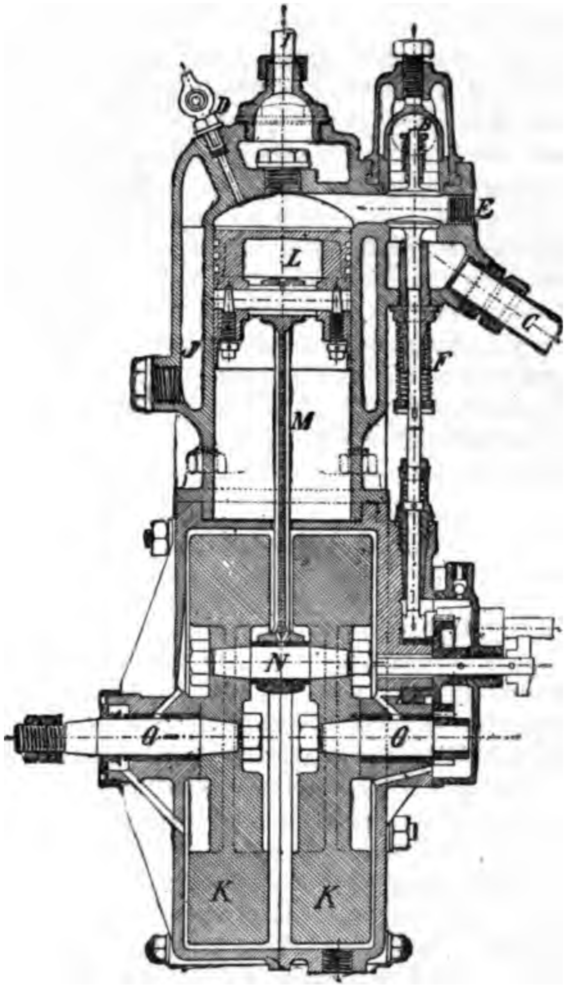
DE DION-BOUTON PATENT SPRAY CARBURETTOR

tion, but without affecting the compression. This arrangement is extremely satisfactory with a small high-speed motor of this type, as it enables the driver to adjust the power of the engine exactly to its work, at the same time reducing the consumption of petrol and the noise and vibration to a minimum.

The carburettor is of the spray type, and is a patent of the De Dion Company. The petrol passes through a vertical tube in the lower part of the carburettor to the float chamber and spray; and an easily removable cap is fitted to collect any dirt

or water that may be present in the petrol. A perfect level is maintained, whatever the inclination of the car may be on the road, because the spray is placed in the middle of the float chamber and not outside it, the float being made in the form of a hollow ring. The suction of the motor draws in air through a separate passage, this current of air being made to pass over the spray, out of which it sucks petrol, and draws it with it into the cylinder. This opening is divided by a shutter, which allows some or all of the air to be deflected so as to pass over the spray, the other portion passing direct to the motor. This shutter is regulated by a lever worked from the driver's seat, so that he can maintain a constant mixture at all speeds of the motor. This movement also increases or reduces the suction on the spray, by increasing or reducing the air-opening into the carburettor. This arrangement has been found in practice and in careful hands to secure a mixture perfectly adjusted to the speed at which the motor is running.

The transmission is through a universally jointed shaft, which communicates with the speed gear, to the de Dion patent expanding clutches. This, which is contained in an aluminium gear-box, gives two forward speeds and a reverse. The two forward speeds are obtained from a secondary shaft containing toothed wheels which are always in mesh with corresponding wheels on the driving shaft, but which either revolve freely about the secondary shaft or are locked to and revolve with it according to whether the clutches within the toothed wheels on the secondary shaft are expanded or contracted. This expansion and contraction are attained by the longitudinal movement of a rack which engages with pinions that expand or contract the segmental clutches. The reverse movement is obtained by the interposition of a pinion between two of the gear wheels on the different shafts. The reverse pinion is always engaged, but the positions of two of the clutch boxes are moved to bring the reverse drum over the clutch, which otherwise actuates the high-speed gear. The chief feature of the De Dion gear is that it is almost impossible to injure it, or to cause a jar or jolt in the car even by the most careless and ignorant driver. The whole of the gear contained in the gear-box is served by dash lubrication, and channels are provided to catch the oil and lead it to the ball bearings of the two shafts. The rear end of the secondary



DE DION 6 H.P. MOTOR, SECTIONAL VIEW

A—Oil Outlet.
B—Gas Inlet.
C—Exhaust Outlet.
D—Compression Tap.
E—Sparking Plug-hole.
F—Spring of Exhaust Valve.
I—Water Outlet.
J—Water-Jacket Plug.
K K—Fly-wheels.
L—Piston.
M—Connecting Rod.
N—Axle connecting Fly-wheels.
O O—Motor Axles.

shaft carries a bevel wheel which drives the differential gear on the rear axle.

The steering is of the irreversible worm and segment type with an inclined wheel pillar, separate pillars being provided for carrying the levers that operate the change-speed gear, ignition, air supply to carburettor, and exhaust-valve lifter. Band brakes are applied by a lever to the hubs of the driving wheels, and a metal shoe brake is applied by a pedal to a metal drum on the counter-shaft. The particular form of high-tension ignition used on the De Dion cars makes the use of high-powered accumulators unnecessary, a dry battery of small dimensions supplying all the current that is required. The price of the complete car illustrated, with victoria top, wind shield, side doors, and special box at the back, is £288 13*s.*; but the same car with a simpler type of body can be had at prices ranging from £200 to £260.

THE OLDSMOBILE

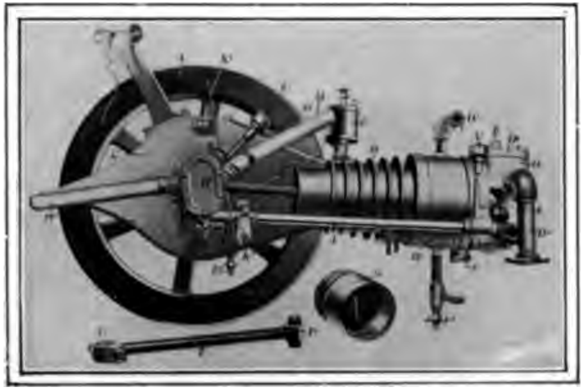
One of the most popular of the light cars is the Oldsmobile, a machine in which are combined all the cleverness and ingenuity of American construction with the fewest possible disadvantages of lightness and American ingenuity. In some of the earlier models of this machine there were some troublesome little defects both of design and workmanship, but so far as I can see these have been eliminated in the 1904 model, which is a thoroughly honest little car; and the enormous numbers in which it has been sold in this country as well as in America afford a sufficient proof of its popularity as a fine-weather car for use either in town or country. The first thing that is noticeable in its general design is that it has no frame in the ordinary sense of the word. The fore and rear axles are connected only by the two long truss-shaped springs that carry the engine and body. The wheels are neat and well built of seasoned wood, fitted with single-tube or detachable pneumatic tyres of quite sufficient diameter for the purposes of the car. This system of frame construction looks absurdly flimsy on paper, but as a matter of fact it is not only very strong, but it is horizontally extremely rigid, and is only flexible and elastic in those directions where flexibility is required to take up the vibration

of road inequalities. As will be seen from the illustration, the 6 h.p. engine is placed horizontally in the centre of the frame, or slightly to the rear of it, the chief weight being thus borne by the driving wheels. The principal features of the engine are the extreme relative weight and size of the fly-wheel, which has much to do with the wonderfully smooth running of this motor, a remarkable silence also being attained by means of the special pattern of silencer. The engine is of large size, 4½ inches diameter by 6 inches stroke, and runs at a comparatively low speed, the maximum number of revolutions per minute being 760. This also helps in the solution of some of those problems of vibration which are often a trouble to the designers of light cars. The carburettor is especially ingenious and efficient. It is of the mixing-valve type, the suction of the piston acting so as to draw air through the carburettor. The passage of this air lifts a small valve which normally rests on the nozzle of the petrol supply, and so impregnates the air with petrol vapour. A needle valve regulates the supply of petrol which can flow to the nozzle, and needs only to be adjusted when the engine is started. The inlet and exhaust valves are placed in a chamber at the end of the cylinder and are both normally held in their places by springs, the valve chamber being so arranged that by the removal of a cover both valves are accessible for the purposes of inspection and regrinding. Both are operated mechanically by the usual means of levers thrust up by cams placed on the half-time shaft which is shown in Fig. 2. The exhaust-valve cam has an additional projection which lifts the valve only half its distance, and thus produces a half-compression which is of material assistance in starting the engine. This mechanism is normally out of gear, but is brought into activity by means of a pedal which the driver presses when he is about to turn the starting handle.

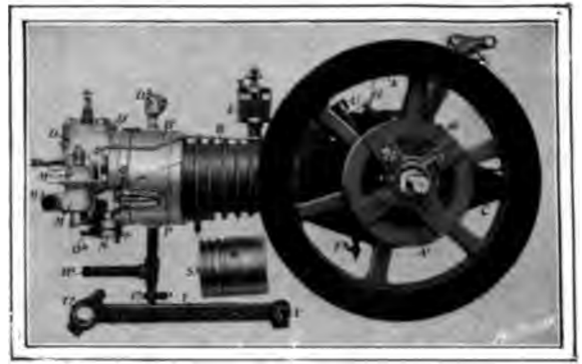
The ignition is of the ordinary high-tension type, and is fed by two sets of four-volt dry cells. The current passes through a trembler coil, and the time of the firing is controlled by a simple "make-and-break" commutator placed on the half-time shaft which is seen at K in Fig. 2. A sparking plug is fitted into the end of the cylinder, where the charge is fired by the usual jump-spark ignition. The engine drives direct from a

pinion on the crank shaft, which is coupled by a chain to another pinion surrounding the differential gear on the rear axle, the top speed being thus a direct drive. On this speed the Oldsmobile is almost as silent and as free from vibration as a steam car; in fact, on its first appearance in this country it was often mistaken for a steam car, as no petrol vehicle was then known to run as silently as the Oldsmobile. A low gear is also provided for hill-climbing, and is obtained through a Crypto device which is locked by means of a friction clutch when the high gear is desired. A reverse is also attained in the same way. What is remarkable about the Oldsmobile car is the unusual elasticity of the top speed, on which the car will not only climb fairly steep hills, but can actually be started from a state of rest. The speed of the car on the direct drive is controlled by the throttle, which actuates a valve in the mixture chamber, and is moved by a pedal under the driver's foot. The gear change is quite without jar or shock, and is controlled by a lever on the right hand of the driver. The steering is by a centrally placed tiller held in the driver's left hand; this works through an O-shaped transverse spring on the front axle, and transmits no road shocks to the steering handle. The starting handle is placed on the side of the car, so that the engine can be started without the driver leaving his seat. The lubrication of the piston is by a sight-feed lubricator which can be turned on or off from the driver's seat. Grease cups are provided on the crank shafts and oil cups on the half-time shaft; a drain cock is fitted at the bottom of the crank-shaft casing to admit of the dirty oil being drained off. The engine is cooled by means of a water circulation which, unlike that of most water-cooled engines, does not include the whole of the cylinder, but only passes round the cylinder head and valve chamber, the lower part of the cylinder being cast with large webs on its circumference for the purpose of increasing the exposed surface. The water is driven from the tank through the water-jacket and thence to a radiator placed beneath the footboard by means of a centrifugal pump driven from the left end of the crank shaft. Large water and petrol tanks are provided, allowing for a run of 100 miles without refilling.

The top speed of the Oldsmobile is from twenty to twenty-five miles an hour, and this it can maintain on good roads for long



LEFT-HAND SIDE



RIGHT-HAND SIDE

FIG. 2

OLDSMOBILE ENGINE

A—FLYWHEEL
A1—CRANKSHAFT
B B—REAR PORTION OF CRANK CHAMBER AND FLANGED PORTION OF CYLINDER
B1—WATER JACKET TO CYLINDER
C—FORWARD PORTION OF CRANK CHAMBER
D—CYLINDER HEAD AND VALVE CHAMBER
D1—VALVE CHAMBER INSPECTION COVER
D2—EXHAUST PIPE
D3—WATER UPTAKE FROM CYLINDER JACKET
E—CYLINDER LUBRICATOR
F—COMPRESSION RELIEF COCK TO CYLINDER
F1—COCK FOR DRAWING OFF WATER IN WATER JACKET
F2—COCK FOR RUNNING SURPLUS OIL OUT OF CRANK CHAMBER
G—INSPECTION COVER TO CRANKSHAFT
H—SUCTION PIPE FROM CYLINDER JACKET
H1—PUMP CASE
H2—DELIVERY PIPE TO RADIATORS

I—HALF-TIME SHAFT
K—COMMUTATOR
K1—ROD FROM IGNITION ADVANCE LEVER
L—EXHAUST VALVE LIFTER AND SPRING
M—LOWER PORTION OF CARBURETTER
M1—UPPER PORTION OF CARBURETTER
M2—AIR SUPPLY PIPE
N—CATCH POT
O—NEEDLE VALVE TO PETROL SUPPLY
P—PETROL SUPPLY PIPE
R R—CHANGE SPEED GEAR BOX
S—PISTON
T—CONNECTING ROD
T1—SMALL END OF CONNECTING ROD
T2—BIG END OF CONNECTING ROD
U—FORCED FEED LUBRICATOR TO CRANKSHAFT
V—LUBRICATOR TO HALF-TIME SHAFT BEARING
X—FORCED FEED LUBRICATOR TO PUMP WHEEL SPINDLE

THE BELSIZE 6-H.P. CAR

stretches at a time. It is a fine-weather vehicle, but a hood can be supplied for use in wet weather—a very doubtful advantage. I can say from personal experience that it is an admirable car to drive in traffic. On the occasion of the late Duke of Cambridge's funeral I happened to be driving in an Oldsmobile from Mayfair to South Kensington, and got caught in the block in Park Lane for half an hour. There was absolutely no movement in the line, but although the engine was running the whole of this time, there was not the least sign of overheating. Afterwards we proceeded at a snail's pace, constantly starting and stopping, and travelling a few yards at a time in the heavy mass of traffic going down Knightsbridge; and although we occupied something like forty minutes in going from Hyde Park Corner to South Kensington Station, and were constantly being caught between buses, vans, and hansom-cabs, the car was absolutely under control in every possible way. By allowing the clutch to slip, it could be driven at an almost infinitesimal pace; and on the other hand could always be jumped forward and pulled up again when an opportunity presented itself. There was no sign of overheating and no unpleasant vibration. Messrs. Jarrott & Letts, who sell the Oldsmobile in this country, have reduced its price from £175 to £150. Mr. Jarrott tells me that before he decided to undertake the sale of these cars, he and Mr. Letts had them thoroughly taken to pieces, and themselves examined and tested every separate part, as they were determined not to identify themselves with the sale of a flimsy or unsatisfactory vehicle. That the car should have survived this severe ordeal by such extremely interested critics is, I think, a very good testimonial to its qualities; while the fact that two Oldsmobiles secured the gold and silver medals in the Automobile Club's reliability trials in 1903 is evidence of endurance through a really severe test. The Oldsmobile also climbed Snowdon in fifty-seven minutes—a piece of vandalism which I suppose must be counted to its credit as a machine.

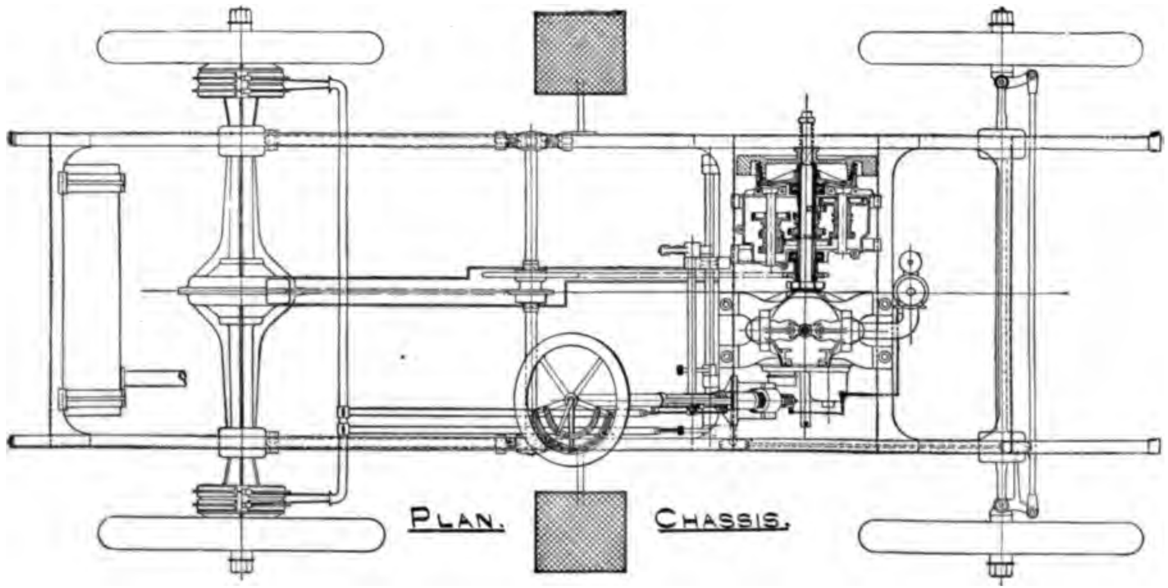
THE BELSIZE JUNIOR

A very interesting little car is the Belsize Junior, which is made by the Belsize Motor-Car and Engineering Company, Limited, of Clayton, Manchester. This, as will be seen from

the illustration, is a two-seated car built on the lines of a large touring car. It is driven by a single-cylinder 6 h.p. vertical engine 4½ inches by 5 inches in dimensions, but capable of developing 7 h.p. at 1,000 revolutions per minute. Both valves are mechanically operated and interchangeable, and a feature of the Belsize construction is that by the removal of one nut both valves and their seats can be taken out for the purposes of examination or for regrinding. A spray carburettor is fitted, and the engine is governed on the inlet; high-tension ignition is effected through a trembler coil and wipe contact. The drive is by means of a chain from the engine sprocket to a transverse counter-shaft in the middle of the frame, and thence again by chain to the sprocket surrounding the differential gear on the rear axle. One lever provides three forward speeds and one reverse, the drive on the top speed being direct. The throttle and ignition levers are placed on the quadrants on the steering wheel, and the usual double-acting brakes are provided. The chains are covered in from mud and dust, although the chain guard is not shown in my illustration. The engine is water-cooled by means of an internal cog-wheel pump driven direct from the crank shaft, the water being contained in a honeycomb radiator. The car is remarkably well finished; there is plenty of room for tools, spare parts, and even for luggage, and the makers are to be congratulated on their practice of fitting large tyres of the very best manufacture on the artillery wheels, this being a matter in which the makers of cheap cars are often given to unwise economy. The price of this car is 175 guineas.

THE BABY PEUGEOT CAR

The Baby Peugeot 6½ h.p. car was one of the pioneers of low-priced motor-cars built more or less on the lines of large vehicles. It has earned for itself a worthy reputation in England, where it has become immensely popular; and justly so, for it is low in price, soundly designed, well built, and combines simplicity with a reasonable durability. It has a vertical single-cylinder high-speed engine placed in front of the car under a bonnet, the drive being through a change-speed gear actuated by sliding spur wheels to a propellor shaft which drives the live rear axle. It seats two persons, and contains ample room for luggage,



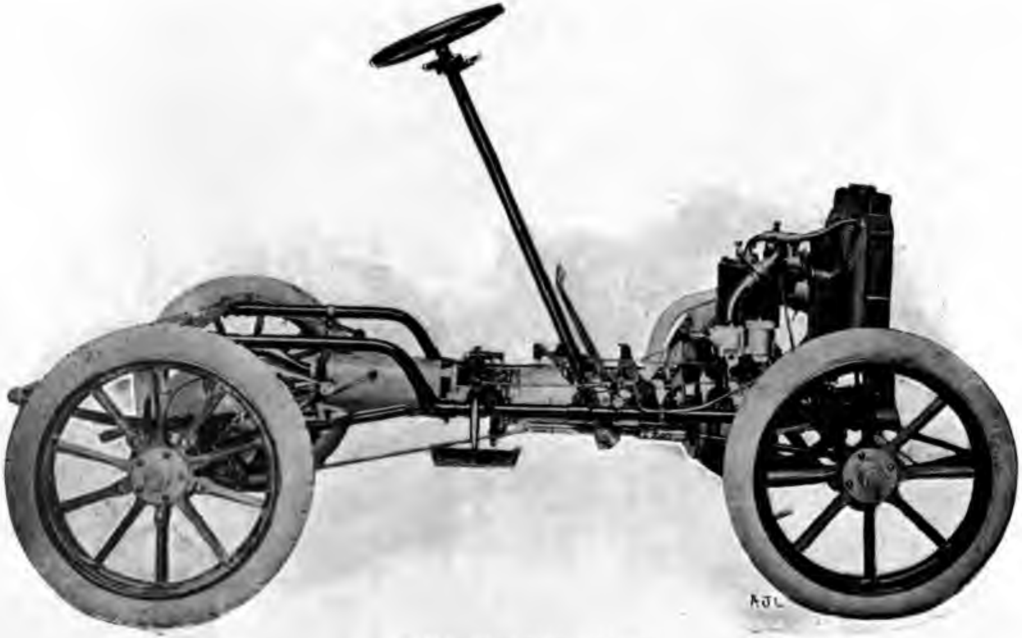
6 HP BELSIZE JUNIOR.

BELSIZE MOTOR CAR & ENGG CO LTD,
CLAYTON.
MANCHESTER.

tools, and spare parts. The main frame is of steel tubes, the side members of which are curved upwards in the rear part of the car, and terminate in plates which are fastened to the highest portions of the semi-elliptic rear springs. The engine is secured by means of the crank case to the frame itself. The single cylinder has an equal bore and stroke of 110 mm. It is scientifically designed, and develops a high power in proportion to its dimensions; it gives about 7½ h.p. on the brake when running at about 1,000 revolutions. Vibration is reduced by ample fly-wheel capacity, and further balance is secured by the provision of two fly-wheels instead of one. The inlet valve is automatic and is situated on the top of the cylinder above the exhaust valve. The mixture passes through a throttle valve on its way from the carburettor to the inlet valve, the throttle being controlled by a lever on the steering wheel. No attempt is made—and in small engines this is a wise policy—to provide for an absolutely automatic mixture at all speeds of the engine, but a hand-lever is provided on the steering wheel by means of which more or less air can be supplied to the carburettor, and the mixture thus varied according to the speed. The ignition is on the ordinary high-tension system, the commutator being in this case placed in front of the car at the front end of the cam shaft, its position, by which the timing of the spark is affected, being controlled by another lever on the steering wheel. The water for cooling purposes is contained in a combined radiator and tank of the honeycomb pattern, and is driven through the water-jacket of the engine by means of a centrifugal pump which is run by friction off the fly-wheel. A fan, placed immediately behind the radiator, is driven by a flat belt from the engine shaft.

The transmission is simple and effective. A cone clutch, the inner member of which has a leather face, drives the clutch shaft through a gear-box containing a second-motion shaft; but by means of a jaw-clutch it drives direct to the propellor shaft on the top speed. There are three speeds and a reverse, obtained in the usual way by spur wheels sliding on the clutch shaft and engaging with corresponding wheels on the second-motion shaft. A brake-drum is carried on the driving shaft, and there is a gently acting brake also fitted in connection with the clutch, which automatically retards the speed of the gear shaft

THE BABY PEUGEOT CAR



6½-H.P. PEUGEOT CHASSIS

when the clutch is depressed in changing speed. The gear-box is automatically lubricated from the drip-feed lubricator fixed on the dashboard. The propellor shaft, which is universally jointed, drives direct to the differential gear on the main axle.

The wheels are of the artillery type, the wheel base being 5 feet 7 inches, and the track 3 feet 6 inches. External band brakes are applied to the drums on the rear wheels by a large lever at the driver's right hand; the drum brake on the driving shaft is applied by a pedal which also engages with the clutch pedal. All other control is on the steering pillar itself. Steering is by wheel, operating a rack and pinion gear through a sloping pillar. On this pillar are fixed four small levers controlling respectively the throttle valves, the change-speed mechanism, the air supply to the carburettor, and the time of the ignition. The top speed of this little car is about twenty-eight miles an hour, and its price is £195.

THE ROOTS PARAFFIN CAR

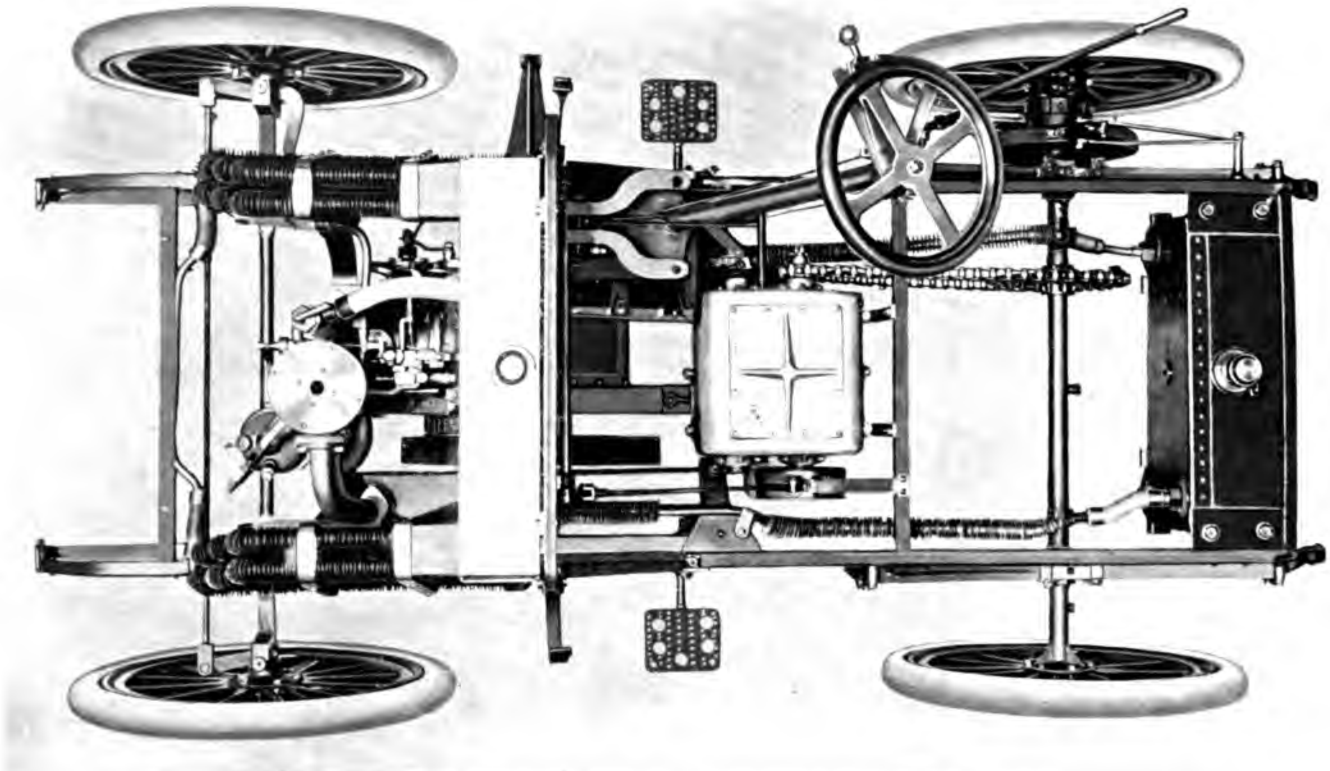
The distinguishing feature of these cars, which are manufactured by Sir W. G. Armstrong, Whitworth & Co., for the Roots Oil Motor and Motor-Car, Limited, is that the only fuel used is ordinary commercial paraffin. The main features of the car will be seen in the illustration, but the point that will more particularly interest my readers is, of course, the motor itself. The utilisation of paraffin for motor-car work has been attended with several difficulties which have been for some years past successfully overcome by the "Roots" motor, and this motor has now been developed to a point at which it is as flexible in working as the ordinary petrol motor. The advantage of oil or paraffin over the dangerous volatile petrol spirit lies not only in the greater safety in the working of the car, but also in the reduced running cost, which is from one-third to one-fourth the price of running a petrol-spirit car.

The motor is extremely simple, and as regards the ordinary working parts presents no special features. It is in the oil-feed and the vaporiser that we find a special point of interest. The oil is conveyed to the oil-feeder, in which works a spindle with a reciprocating motion, and this spindle carries forward at every stroke a measured quantity of paraffin which flows into the

vaporiser and is vaporised by the rapidly moving current of heated air passing to the cylinder through the vaporiser. Two kinds of ignition are used—tube ignition, by which the tube is heated by a lamp for starting, and electric ignition for running. When once the engine is started the lamp can be extinguished, and the engine then runs on the electric ignition, the vaporiser being kept hot by the exhaust gases passing round it. The current for the electric ignition may be generated either by magneto machine or by accumulator.

The governing of the engine is performed by a centrifugal governor on the half-speed shaft, which, by means of a hardened steel block, prevents the exhaust valve entirely closing, and also limits the travel of the oil-feed spindle so that the oil groove in it does not enter the chamber communicating with the vaporiser. Nominally the speed of the engine is 750 revolutions per minute, which can be reduced to 400 revolutions per minute or increased to 850 without any detriment to its working. The motor drives by means of a friction clutch and a Renolds chain to the gear-box, which is provided with three speeds and a reverse. One small hand-lever placed on the steering column underneath the wheel controls the speed changes. The spark adjustment is also attached to the steering column on the side opposite to the speed lever. Two pedals are provided, one for the clutch and brake, the other for the brake only. The brake-lever movement releases the clutch before applying the brakes. From the gear-box a roller-chain drives the live back axle upon which the differential gear is fitted. Ball bearings are fitted to all four wheels, and the maximum speed of the car with the gear is twenty-one miles an hour on the level at 750 revolutions of the engine.

It is probable that before long the exorbitant price of petrol will bring to the front the use of the paraffin motor, not only for the pleasure or ordinary motor-car, but for all commercial vans and lorries. When a fuel of one-fourth the price can be utilised economy becomes a very prominent advantage. For the tropics and places abroad the paraffin car is essential, owing to the prohibitive price of petrol and its increased danger in hot climates. In Calcutta, for example, petrol costs 3*s.* 6*d.* to 4*s.* per gallon, while paraffin costs about 1*s.* 2*d.* per gallon. The 5 h.p. Roots car, which, fitted with solid tyres, is sold at



CHASSIS OF THE ROOTS PARAFFIN CAR

6-H.P. WOLSELEY CAR

£196, can run about thirty miles on one gallon of common lamp oil. For economy in running, therefore, it has few rivals, while Sir W. G. Armstrong, Whitworth & Company's name should be a sufficient guarantee that the expenditure on repairs will not be heavy. The 12 h.p. cars by the same firm are fitted to carry four, six, or eight persons. The same chassis is made also as a light lorry to carry twenty-five hundredweight, and with a slightly longer chassis they are made as covered vans to carry thirty hundredweight.

THE WOLSELEY LIGHT CAR

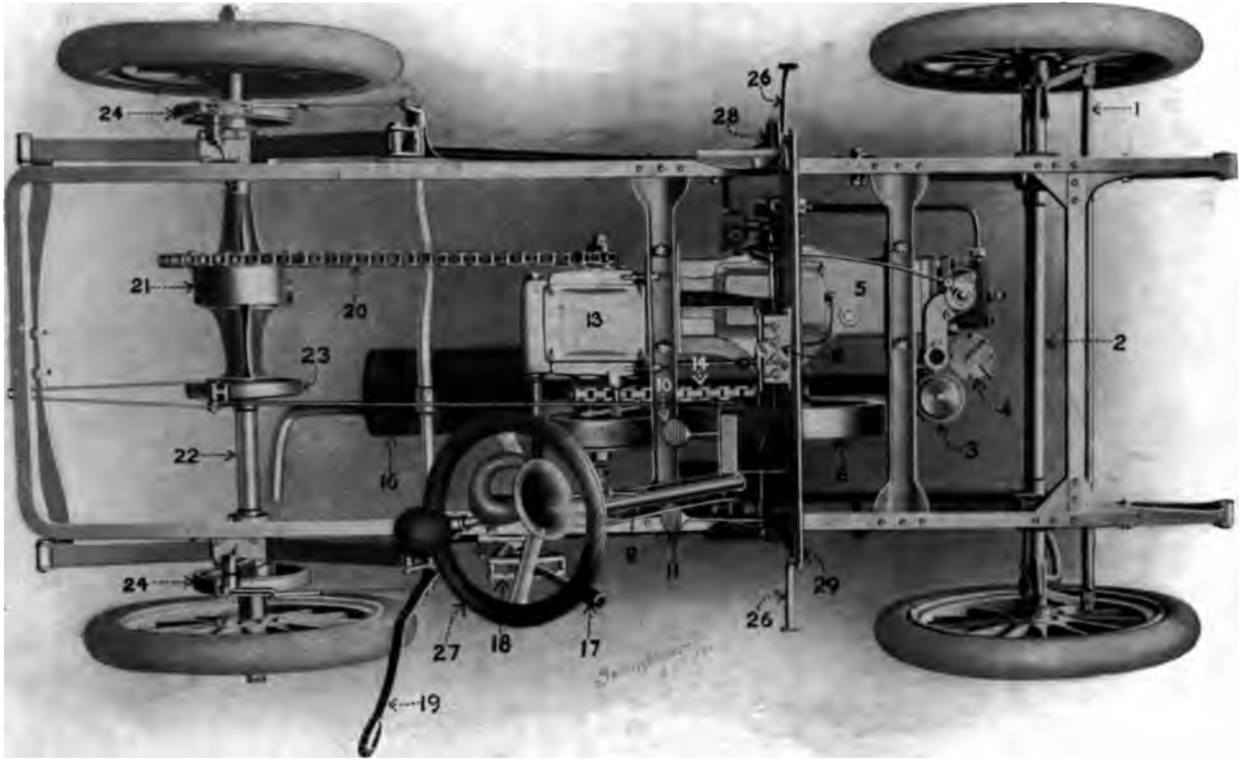
The Wolseley Company have devoted no little time and trouble to meeting the demand for a cheap and simple light car in which only the highest quality of workmanship and material are used. Their system of construction, employing a horizontal engine, is readily adaptable to the limitations of design imposed in a cheap and light car of low horse-power; and the merits of their system are in no case seen to better advantage than in the 6 h.p. light car, which is sold complete for £175. In principle the design is practically identical with that of the larger cars described in Chapter IV.; but some slight modifications have been introduced for the purpose of reducing the cost of construction. The engine has a single cylinder 4½ inches in diameter by 5 inches stroke, and works at a speed of from 800 to 900 revolutions per minute. The inlet valve is atmospheric, and the only gearing required on the engine itself is that which actuates the exhaust valve and the pump. The transmission is, like that in the larger cars, by a Renolds chain from the motor to the gear-box, but at this point a change has been made in the interests of lightness and economy. There are only three forward speeds and a reverse, and the gear-box, instead of being in connection with a differential shaft, is self-contained, and a single roller-chain drives from it to a live rear axle in which the differential gear is situated. The arrangement of brakes is also different. A band-brake on the differential gear-box is operated by a foot pedal, and the hand-lever actuates double-acting band-brakes on the driving wheels of the car.

All the other Wolseley characteristics are to be found on this

vehicle; the throttle valve and ignition are both controlled by levers on the steering pillar; cooling and lubrication are on the standard Wolseley lines; and the mechanism for producing half compression when the motor is being started is also provided. The car has two comfortable seats with ample room behind for luggage, tools, and spare parts; the wheels are of artillery pattern and are fitted with heavy Dunlop 28-inch tyres, although this little vehicle is quite able to endure the vibration caused by the use of solid tyres on the driving wheels. It is capable, when fully loaded, of maintaining an average speed of twenty miles an hour, which, considering the small dimensions of the engine, indicates a very high degree of efficiency in the motor and transmission. The frame is of I-section steel, and is carried on semi-elliptical springs, the two rear ones being connected by a transverse spring. The Wolseley light car has distinguished itself in all the reliability trials for which it has been entered; and its smart lines and neat finish, combined with the really high class of workmanship and material that are put into it, have already earned for it a wide and increasing popularity.

THE HUMBER CAR

The Humber Company have long enjoyed a great reputation as cycle builders, and are sparing no efforts to secure a similar position in the motor industry. Their light cars are made in 5 h.p., 6½ h.p., and 8½ h.p. The small cars have single-cylinder engines developing their normal power at about 1,500 revolutions, and are capable of speed up to about twenty-five miles an hour. The frames are of steel tubing. Float-feed carburettors of the Longuemare pattern are employed, and the engines are governed automatically. The drive is by a universally jointed shaft from the gear-box in the centre of the car to a live axle on the rear wheels. The chief feature of these little cars is their extremely low price, which ranges from 125 to 160 guineas.



1—STEERING ROD
2—FRONT AXLE
3—AIR BOTTLE
4—FLOAT CHAMBER
5—MOTOR
6—FLY WHEEL
7—IGNITION COIL
8—LUBRICATING OIL RESERVOIR
9—STEERING PILLAR
10—BRAKE PEDAL
11 CLUTCH PEDAL
12—CLUTCH
13—GEAR BOX
14—RENOLD'S CHAIN
15—EXHAUST PIPE
16— ,, BOX
17—GEAR LEVER
18— ,, QUADRANT
19—HAND-BRAKE LEVER
20—DRIVING CHAIN
21—DIFFERENTIAL BOX
22—BACK AXLE
23—BAND BRAKE (FOOT)
24— ,, ,, (HAND)
25—RADIUS ROD
26—LAMP BRACKET
27—STEERING WHEEL
28—STARTING-HANDLE BRACKET
29—DASHBOARD
30—THROTTLE LEVER
31—IGNITION ,,

CHASSIS OF THE 6-H.P. WOLSELEY CAR

CHAPTER IX

THE USE AND RUNNING OF A MOTOR-CAR

A difficult art—The perfect driver—Learning to steer—An obstacle race—The folly of knowing only the handle end—Incident of the two brothers—Starting for Wales—Incident in the Kew Road—Incident of the traction-engine—Incident of the rope and the cab—Sweats, bruises, and terrors—*Fervidis rotis*—Complete demoralisation of the brothers—Moral—Learning to control a car—Starting the engine—Changing speed—The use of the clutch—Driving on hills—Where a collision is desirable—Use of the ignition lever—Driving on the throttle—Overheating—Improper lubrication—Vagaries of the carburettor—Starting on a journey—Supplies to be carried—A last look round—The first few miles—Taking risks—The cow, the dog, and the hen—Mental endurance—Men and horses—A plea for decency and humanity—The motor hooligan—Things to remember—Women, children, and dogs—The unattended horse—The world of the village street.

THE proper management of a motor-car on the road consists of many things. It is easy to learn to steer; it is easy to learn to change speeds, to use the clutch, to regulate the ignition and the explosion mixture; but these things belong only to the elementary education of an expert motorist. At the same time, they are the only parts of the science that can be actually taught; everything else must be learned by actual experience on the road and by a close study of the principles on which the car is constructed. Almost anybody can learn the elementary part of motor driving, but comparatively few ever attain to the perfection of competence which implies an acute sympathy with the mechanism which is being controlled, a vision quick to observe, a mind quick to notice, hands quick to act—the perfect ear and touch, in fact, of which I have already spoken. The first-rate driver of a motor-car is he who anticipates every variation of the mechanism under his control, preventing, rather than waiting to correct, its aberrations, foreseeing and avoiding difficulties of traffic rather than

extricating himself from them, and noting subconsciously the hundred and one trifling incidents in the behaviour of the machinery that go to make up its life and express its idiosyncrasies.

Before even learning to steer a motor-car it is necessary to know how to control any vehicle on the public roads. In my opinion the people who make the best drivers of motor-cars are those who have been accustomed to handle yachts and small boats—the machines, that is to say, in which the art of steering has been brought to the greatest nicety, which are entirely governed by external conditions over which the occupant has no control, and to which he must on the instant adapt them. The next best training is that afforded by the ordinary bicycle; it trains the eye to an approximate judgment of distances and to steering on the ordinary public roads. All the same, it must be remembered that the bicycle is a machine steered by balance and the equilibrium of the rider's body, with which it forms a dynamic unity, and the variations of which it tends to correct. So that steering on a bicycle is really a matter of will more than of muscular action, and is in that way quite different from the steering of a motor-car. Nevertheless, as the speed of a bicycle is commonly in excess of the ordinary road vehicles, its use is a very good introduction to the science and art of motoring. Next to the bicycle the best means of learning to drive a motor-car is probably the ordinary horse-drawn trap. In this the driver cannot or ought not to act merely subconsciously as in the case of the bicycle; he must be alert to the conditions surrounding him, and in order to produce a change in the direction or speed of his vehicle, must not only experience an impulse in himself, but must communicate it to the animal drawing his carriage. The width of a horse-drawn vehicle, moreover, being approximately that of a motor-car, the use of it provides a valuable education and experience in driving in traffic where distances have to be judged with great exactness, and where the driver must know at a glance whether there is or is not room for his vehicle to pass.

Some one of these experiences is certainly necessary as an introduction to motoring, and equipped with it, the novice will find steering a matter very easily learned. This should be studied and practised quite apart from the control of the

machinery, and should be practised, if possible, on a lonely and empty road. The engine having been started, the car should be put on its first speed, and an experienced motorist should sit on the left-hand seat and control the clutch pedal. The novice may then set himself to steer straight along the road for a given distance. At first his whole tendency will be to turn the wheel or tiller too far in either direction, so driving the car along a zigzag course. This tendency, however, will very quickly disappear, and the learner, after having driven for a little while on the low speed, may proceed to the second. If his first lesson has been properly learned, he will find that straight steering is much easier at the slightly higher speed; but the attention and concentration which his task demands will possibly prove very exhausting; and he should begin by driving on the higher speed only for a few hundred yards at a time. He should also practise steering backwards until he can do so with complete confidence. The mastery of this stage will probably prove quite a sufficient study for the day; and a second day should be devoted to steering with either hand singly until the same ease of control is secured as with two hands.

The arrangement of most cars makes it impossible for the novice to study steering any farther, apart from the control of the speed mechanism, as on a car of the standard type it would be dangerous and very difficult for a person seated on the left of the car to attempt to control the speed levers and brakes as well as the clutch. In a Lanchester car, or any similar type in which all the controlling levers are situated between the two passengers, the steering lesson may profitably be continued until the beginner has learned to steer the car with perfect precision and confidence at its top speed. Steering on a straight road, however, is only a small part of the lesson, which should be continued in a large courtyard or fairly level field, if one can be found. Obstacles, such as boxes and cans, should be variously placed on this manœuvring ground, and some of them being only sufficiently far apart to allow the car to pass between without touching them. Another good way to practise on a large paved space is to drive the car along marks made on the ground by means of chalk or whitewash; and after a very few days at these exercises the learner will have begun to feel quite at home with the wheel or tiller of his car, and will have mastered

that essential principle of all steering, which requires that all movements of the steering apparatus should be corrected as soon as they begin to take effect. This principle is best illustrated in the handling of large steamers, which, when they are being steered at very slow speeds, often require the complete reversing of the helm before any movement is perceptible. Thus if it is required to turn a large slow-moving steamer to starboard, the helm will have to be put hard over to port and held there until the vessel's head begins to come round; and the moment it begins to do so it will be necessary, as they say, to "meet her"; that is to say, to spin the wheel round hard a-starboard again in order to arrest the turning movement in time. These movements in an infinitely more rapid and finer degree are exactly what take place in the steering of a motor-car; and it is by the unconscious and automatic correction of every steering impulse that secure and perfect guidance is obtained. Another principle in steering is to keep the eyes fixed on the road some distance ahead of the car, and not on the front wheels of the car themselves. By this means jerky steering is avoided, and any deviations that are necessary are made through large arcs and smooth, wide curves.

The principles of steering having been mastered and a fair degree of confidence and assurance attained, the control of the mechanism may be tackled. This differs in detail in different cars, but there are certain principles of construction and control which apply to the great majority of petrol-driven cars. I need hardly say that the first step in learning the control of any mechanism is to study the mechanism itself and to grasp the principles on which it works and by which it is controlled. Nothing can be more fatal than to know only the handle ends of the various levers, and to be entirely ignorant of what happens underneath the footboard when they are moved. This ignorance is the cause, not only of countless minor accidents, but of much of the disappointment and disillusion of many would-be motorists, and of not a little of the commonly held prejudice that motoring, even at its simplest, is a difficult and dangerous pastime. I knew a man who, after a long residence abroad, came home on six months' leave and decided that he would like to spend part of the time touring in England on a motor-car. He went to the Army and Navy Stores and bought

a car of a well-known make and (fortunately for him) of small horse-power. He hired the services of an "expert," who gave him two days' instruction in the management of the car; and he then decided that he would start for Wales the next day.

We may pause for a moment to consider the situation of this man, his courage, and his folly. He knew absolutely nothing about machinery; the petrol motor itself was a nightmare of mystery to him; he knew neither the purpose nor action of crank, valve, or carburettor. His two days' instruction had taught him that when he (or rather the instructor) had moved certain levers, certain things had happened; and these miracles of cause and effect he had, by I know not what toilsome intellectual effort, committed to memory. Thus doomed, he started early one morning, accompanied by a brother as innocent as himself, to drive into North Wales.

The morning broke sunny after a night of rain, and the streets of London lay shining with the smooth and inviting surface which in this condition they offer to wheeled vehicles. It was in the Chiswick High Street that the inevitable happened, and our daring voyager saw the street begin to revolve about his car, and himself, his brother, and his new possession all being precipitated sideways with the speed of an arrow towards the monstrous and inexorable approach of an electric tram-car. Something stopped in time, of course; there would be no motorists alive if things did not, in the early days, stop in time; and we may picture a shaking and sweating proprietor alighting from his natty, smartly-painted vehicle, wondering what he had done or not done, what law of nature he had transgressed, that the world should thus apparently swing out of its course in order to destroy him. Fatal, devoted innocent, thou wert then but on the borders of knowledge! No one had forewarned thee of side-slip; yet a hundred other things, prepared for thy learning and bewilderment, lurked within the future of that sunny morning!

I forget the details of the journey and of the many tragic and humiliating things that happened to the brothers; how they crept northwards through England, now towed by a traction-engine, now at the tail of the harmless, necessary cab, now (the gods being for the moment propitiated and the miracle compassed!) crawling along on their own first speed. Daily the face

of the driver grew more worn, daily his nerves became more and more frayed, daily the nightmare of his occupation grew upon him; and as at the fall of each new evening the car was by some means plucked into shelter and the harassed driver sought his bed, it was but to spend the sleep-forsaken hours of the night telling over in his mind the lesson of the day's surprising adventures, committing to memory a hundred precautions, peering into the dark future for a hundred possibilities of new disaster. And daily it was a more shaken, a more withered, a more haunted and demoralised man who took his seat at the wheel.

> Sunt quos curriculo pulverem Olympicum
> Collegisse iuvat, metaque fervidis
> Evitata rotis. . . .

but I doubt if my poor friend was one of them. The "goal by hot wheels shunn'd" lay too far and inaccessibly before him.

The things that happened to these men were, of course, the ordinary things that would happen to all entirely unwarned and untaught voyagers. I am handicapped in my attempt to give an account of them by the fact that my informant—the passive and therefore, perhaps, the more unhappy partner in the adventure—was entirely ignorant of the names of the simplest parts of the mechanism; but from his obscure narration I have been able to string together something like an account of what really happened. At one time it appears that in trying to start the engine "the handle thing on the top of the dome broke off"; and laborious cross-examination has convinced me that this statement refers to the compression tap, although in what convulsion, in what tortured writhing of the brother who was starting the engine, this occurred, I have been unable to discover. The result, it appeared, took the form of ropes and a cab. At another time, at many other times, indeed, they ran short of petrol; no amount of experience could induce them to "encumber themselves" (that was his word) with a spare can of spirit; and so when all other manners of breakdown failed they seem always to have ran short of petrol. Then their exhaust valve became sooted up and the engine stopped; then they missed their change of speed on a hill, stopped the engine, and nearly ran

backwards to destruction. Then their water system sprang a leak and they never knew it until the car stopped again. After five days of anxieties, bruises, sweats, and terrors, the engine back-fired when they were trying to start her and nearly broke the acting partner's arm. They had by that time travelled about 150 miles from London; the "expert" (who, no doubt, was lying in wait) was wired to, and the car sold for a song. I gather that in the last two days their nerve entirely gave out, and that they became utterly demoralised. On the slightest sign of anything going wrong they made no attempt to deal with it, but scanned the horizon for the nearest cart or traction-engine and signalled for a tow. It was enough if a spring broke or a tap had not been turned on; panic reigned, the rope was produced, and the car dragged to the nearest town. But by what miracle or indulgence it was that they had no ignition troubles, or that they neither inflicted nor suffered death or bodily injury, can only be known to that youthful spirit whom I imagine to be detailed by Providence to the oversight of motoring novices, who tempers the wind of destiny to beginners, and in his mercy prevents them.

This tale has two morals. One concerns the absurdity of a law which allows anyone to buy what may very easily be an engine of destruction to life and property, and to drive it about the public streets without having learned the elements of its nature and control. The other moral is that dislike of motor-cars, whether by the public or by those who have tried to drive them, is more often caused by the folly and ignorance of the users than by faults in the machines themselves. The first duty of every motorist, as I have so often said, is to understand his car thoroughly in every detail.

Having learned, therefore, how his car is constructed and how to steer it in all conditions of traffic, he may proceed to learn and practise its control. The means by which this is effected will be found on cars of the standard type to consist, in addition to the steering wheel, of one or two change-speed levers fixed at the driver's right hand, a brake lever fixed beside them, and two other levers governing respectively the timing of the ignition and the volume of gas admitted to the cylinders. These two levers may either be fixed on the dashboard in front of the driver, on the steering pillar, or, as is the more usual modern

practice, they will consist of two brass arms working in the notched quadrants on the steering wheel itself, the movement being communicated by means of spindles fixed within the steering pillar. In addition, at the driver's feet will be found two or three pedals. One of these is for operating the clutch. When it is in its normal upward position the clutch is coupled to the fly-wheel by means of a strong spring, and the motion of the engine is communicated to the gear; and when it is depressed by the driver's foot the clutch is disengaged, and the engine runs free without driving the car. Another pedal actuates a brake which works on a drum on the counter-shaft or differential; in the case of a few cars there is a second pedal brake working on a drum on the second-motion shaft. These pedal brakes are usually so connected that the act of depressing them disengages the clutch before the brakes are applied, so that the damage which would be done to the engine by applying the brakes while it is coupled is avoided. A third pedal is often fixed, and is called the accelerator pedal; when it is depressed the governor of the engine is thrown out of action, and the number of revolutions, and consequently the power developed by the engine, are temporarily increased. In most of the later cars, however, in which the throttle on the steering post gives a very great range of speed and power in the engine, no accelerator is provided. The action of the brake lever fixed at the side of the car, which applies powerful band-brakes to the hubs of the rear wheel, also, as a rule, fixes the clutch pedal in a downward position, so that when the brake lever is in the "on" position, it is impossible to start the car by slipping in the clutch until it has been released.

These, then, are the means of control provided on the standard petrol car. We will suppose the novice to be about to make his first essay in actually driving his car. The first thing to be done is to see that the respective tanks are filled with water, petrol, and lubricating oil. If the high-tension system of ignition from batteries or accumulators is employed, it must be seen that these are fully charged and connected. A switch will usually be found on the dashboard with three positions, the two outside ones making connection with one or other of the two sets of accumulators carried, and the middle position disconnecting both. The driver should now turn on

the tap which admits petrol from the tank to the carburettor, and switch on whichever of the accumulators he intends to use. He should see that the side brake is on and the clutch disengaged, an additional precaution being adopted in placing the change-speed lever in its middle or neutral position, when none of the gear wheels are in mesh. The throttle should then be opened slightly, and the ignition retarded by the placing of the ignition lever in its most backward position; this is necessary in order to prevent a back-fire of the engine in starting it and the possible dislocation of the motorist's arm or wrist. Having done all these things and seen that the lubricators are fully charged and in working order, he may proceed to start his engine. To do this he must stand in front of and facing the car with the starting handle on his right hand. Placing his left hand on the curved projecting spring of the car, he now stoops down and grasps the starting handle with the four fingers of his right hand, *but not with the thumb*, that is to say, the four fingers should be hooked underneath the handle, the thumb lying loosely along it, and not grasping it as instinct would suggest. The starting handle is so fixed that it has to be pressed slightly in on the shaft before it engages, a light spring being fitted to throw it normally out of engagement; thus pressing it in and pulling it up towards him, he will feel the weight of the engine and compression pulling against him. He should then give a steady pull in order to get the handle up over the dead centre in its top position. If the engine is a very perfect one this one pull will be enough to start it, but more likely it will need several rapid turns of the handle in order to bring about the necessary induction and compression in the cylinders. In making these turns, the motorist, if he desires to avoid the bogey of petrol engines—the back-fire,—will hold his hand in the way I have described, and will exert force only in pulling up the handle and not in pushing it down. It will be necessary, of course, to exert sufficient force in pulling it up to carry it round the rest of the way with the hand loosely engaged. In this way, even if a back-fire occurs, no injury can be inflicted on the arm or wrist, as the crooked fingers will simply be straightened out as the handle violently pulls itself away from them.

It may be, however, that the handle will be turned for a

considerable time and yet the engine will not start. In this case it is no use to go on working oneself into a heat at the handle, and it is better to look round and see whether something has not been overlooked. A common cause of trouble in starting, even with the most experienced drivers, is that the petrol supply has not been turned on; and this is easily remedied. In case of failure to start it is the first thing to be looked for. The next thing is to see that the batteries have been switched on and that the ignition lever is in the right position; with those cars which have a glass-covered spark gap fitted on the dashboard, it is quite easy for someone to see, while the starting handle is being turned, whether or not the sparking is all right. If it is, the fault must be in the carburettor. It is as well to give the needle of the float chamber, which projects upwards through its top, a few light taps with the finger in order to make sure that it has not been stuck. If the petrol supply has been turned on too long before starting the engine, it may be that the carburettor is flooded and is delivering too rich a mixture to the cylinders. In this case the petrol tap should be shut off and the starting handle turned until the inspiration of the engine has used up the excess of petrol, when it will probably begin to start. As soon as it has started care should be taken to turn on the petrol tap again.

Having successfully started his engine, the beginner may take his seat in the car and make his first essay in driving it, although it need hardly be said that the presence of an experienced motorist in the seat beside him is advisable in the interests of safety. The left foot should be placed on the clutch to hold it down, and the side brakes released, when the change-speed lever may be moved from the neutral position to the first speed. The clutch may now be very gradually and gently let in, and as the pedal rises the car will begin to move as the drive of the engine is communicated. The car will now travel forward so long as the clutch pedal is not depressed, but on the clutch being withdrawn it will continue to travel only by its own momentum, which being exhausted it will come to rest. The beginner should practise for some time starting and stopping the car on the first speed before he attempts anything more. He should sometimes stop it with the pedal brake, and

should continue practising this manœuvre until he has become thoroughly accustomed to the fact that the car starts when he lets the clutch in and stops when he withdraws it. A very little practice also will show him how in withdrawing the clutch the movement of the pedal may be sharp and firm, while in letting the clutch in the movement must be gentle and gradual, so that the weight of the drive is not thrown on the engine too suddenly.

The beginner may now proceed to practise changing from one speed to another, an evolution which, with the type of change-speed gear still commonly in use, calls for a good deal of knack and precision of movement. The first step will be to change from the first speed to the second. The car should be set running on the first speed until it has attained its maximum speed; the clutch should be then withdrawn and the speed lever moved quietly and firmly into the next notch. There may be a momentary resistance if the gear wheels are not exactly in the position for meshing, but it will only be momentary, and a firm movement will bring the second speed into operation. The car will now begin to travel faster, and the learner, perhaps a little excited by his efforts, must watch his steering and take care that in the joy of the moment he does not drive into the ditch. As soon as the car is going well on the second speed, he should change back on to the first. All that he has to do on a level road is to withdraw the clutch, and then, as the speed of the car begins to slacken, to move back the speed lever to the second notch and release the clutch pedal. These movements must be practised over and over again until they are done smoothly, quickly, and automatically. At first the learner will find himself going through an elaborate mental calculation every time he changes speed, and trying to remember whether he withdraws the clutch before or after moving the speed lever. But he will soon get into the habit of making the withdrawal of the clutch automatically to precede every movement of his hands towards the levers, whether for the purpose of changing speed or applying the brakes. The expert motor driver is able under certain circumstances to change speed without withdrawing the clutch, but this has nothing to do with the beginner, who will find such things out for himself by long practice on the road.

A day or two spent at driving the car backwards and forwards at different speeds on a level stretch of road will accustom the novice to handling and controlling it. He may then proceed to practise on a more hilly road, where he will find that the act of changing speed requires more judgment and precision of movement than is necessary on a level road, where he varies his own speed simply in accordance with his own wishes, and not because of the gradients of the road. If, for example, he is driving on the third speed and encounters a steep hill it may be necessary for him to change back to the second before the top is reached. To do this he will have to choose the exact moment at which the rate of the car's travel falls below that for which the third speed is calculated and comes into the zone covered by the second speed. The exact moment for the change can only be accurately judged after a good deal of practice, and then if the driver is really in sympathy with his car, he feels rather than thinks that the moment for the change has come. A good rule, however, for the beginner is to change speed down when the engine in climbing a hill begins to give signs of flagging, and to change speed up when, travelling over a falling gradient, the engine begins to overrun and the governor to cut out. In certain cars, particularly Panhards, the musical note caused by the gear wheels is itself a very fair guide to the changing of speed. It rises and falls as the speed of the car waxes and wanes; if the note of any given speed climbs higher and higher in the scale, the driver who is familiar with it soon learns the exact moment at which a higher speed can be put in; if it falls, the same instinct tells him when to change to a lower gear. It should also be remembered that in climbing a hill the gear must be changed very quickly, and the clutch withdrawn for as short a time as possible, otherwise the car will lose momentum so rapidly that it will be travelling too slowly to take the second speed, and the first speed will have to be used. There is danger, also, that if time is lost and the clutch let in too suddenly the engine may be stopped—when the car will, unless the brakes are quickly and powerfully applied, begin to run backward. As this is a very awkward occurrence and may be fraught with extreme disaster, it is a golden rule for the novice in climbing a steep hill to hug the near side of the road. Then, if anything happens, and the car begins to move backwards, it

can be quickly turned into the side of the road before it has gained much speed, and a collision with a bank, ditch, or wall will be nothing at all compared with the possibilities of a fatal accident involved in the car running backwards far down the hill. It need hardly be said that if the near side of the road consists of an embankment or precipice this method of dealing with an emergency is not advocated. In this case the other side of the road may provide a buffer; if not, and if the car is running backwards and gathering speed, the driver must try to effect a collision with some obstruction. If the car has not gained an appreciable speed the results will not be serious; and in any case, in the rare circumstance under consideration, it is better in the first twenty yards to collide with something than with nothing.

When the driver has taught himself to be fairly at home with the change-speed mechanism, and is able to throw different sets of gear wheels into mesh without any jarring noises or delay, he may begin to make little journeys on the car. I strongly advise that at least for the first week the top speed of the car should not be used, and at any rate that no speed higher than twenty miles an hour should be attempted until the driver is thoroughly familiar with the manipulation of the car at low speeds. When the change-speed mechanism has been mastered, the accelerator, throttle, and ignition levers should be studied and the proper use of them added to the beginner's *repertoire.* The accelerator on the Panhard type of car is a device which can be and commonly is much abused. I have seen men driving with the accelerator pedal almost constantly down; needless to say such men do not get long life or the most trustworthy service out of their cars. The accelerator pedal, however, has its uses, notably in changing to a higher speed, when a touch of it just before withdrawing the clutch gives an increased momentum which easily carries the car on to the next speed. It is useful, also, where a sudden change has not been perhaps very skilfully made and the engine threatens to be slowed down; the extra gas thus given to it helps to preserve a steady pace. But there is no vice in driving equal to that of racing the engine on every possible occasion, and in the long run it means trouble and expense.

The ignition and throttle levers form a very important part

of the controlling mechanism of the ordinary petrol car. By the proper manipulation of the ignition lever only can the engine be kept running smoothly and steadily at all speeds, and a proper economy of power effected. With a small volume of gas, and when running at low speeds, the ignition should be kept well retarded, and thus the greatest possible driving impulse will be extracted from each separate charge of gas, which, when it is small in volume, is compressed a little later in the stroke. The ideal conditions of ignition are that the charge shall be exploded at the exact moment when it has reached its highest stage of compression, and this is effected by making the ignition late for low speeds and early for high speeds. As the car gathers speed, therefore, and in proportion as more gas is admitted to the cylinders, ignition should be gradually advanced. If a knocking noise is heard in the cylinders and there is no suspicion of overheating, the case is almost sure to be that the ignition has been too far advanced for the rate of speed. It is better at first to err on the side of keeping the ignition somewhat back; no damage can then be done, and the only result will be that the explosive charges will not then develop their full driving power. If the ignition is too far retarded, however, when the car is travelling fast, it is probable that all the charges induced and compressed in the cylinders will not be ignited, and will explode in the silencer with a somewhat alarming noise, which, although it does no damage, is exceedingly disagreeable and means that the gas is being wasted.

The throttle has recently taken a much more important place in the driving of petrol cars than it used to take. The accepted modern practice is virtually to drive cars on the throttle and to vary the speed, not by a constant changing of gear, but by regulating the amount of gas furnished to the cylinders. By this means something of the flexibility of the steam engine is attained, and it is possible to drive many cars practically all day on the third speed, regulating their rate of travel merely by throttling the gas and, therefore, by regulating the speed and power of the engine. In such cases the lower speeds need only be used in starting and in climbing unusually steep hills. Like everything else in motor driving, the proper use of the throttle is only learned by experience, as it is important not to overtax

the engine by making it do certain work at very low speeds on a high gear, which ought really to be done at higher speeds on a different gear.

A careful study and practice of these matters should in a very short time enable the beginner to steer and drive a motor-car with safety and confidence—so long as the engine performs its work properly. But the moment anything goes wrong and the engine stops, all the skill in driving in the world becomes useless unless the driver is able to diagnose the fault and remedy it. The little accidents and interruptions that may happen to a motor-car are legion; but those that ought to happen to a car that is carefully kept and properly looked over before each day's journey are very few indeed. Nevertheless, the driver who wishes to make his journeys with an easy mind and with a reasonable confidence that he will arrive at the end of the day's run at a given time must be able, not only to find out the cause of any defects that may arise, but also to remedy them promptly. And it cannot too often be repeated that most of the little ailments to which petrol motors are subject can be prevented by forethought; and when they do arise, are generally found to be traceable to something forgotten or neglected. A good petrol engine carefully looked after will run all day, day after day and month after month, without ever breaking down on the road.

Overheating is a danger against which the beginner must be constantly on his guard, as the overheating of the engine may be caused in a variety of ways, and always results in damage which it is an expensive matter to put right. The simplest cause of overheating is for the circulating pump to have broken down or to have become clogged by the presence of some foreign bodies in the cooling water. As all cars which are water-cooled ought to be fitted with an indicator on the dash-board showing whether the water is circulating or not, the first fault ought never to develop far enough to do serious damage before it is noticed; the remedy is, of course, to repair the pump, or (failing that) to travel to the nearest stopping-place in short bursts of five minutes' running at a time, with intervals of twenty minutes waiting while the engine cools. Particles of grit or dirt should never get into the water system if a strainer is used when the tanks are being filled. If the pump gets

choked or clogged, it must be taken out, cleaned, and repacked. Overheating can generally be detected by the smell of burnt paint and oil which rises from the cylinders, and also by a knocking noise which is heard in them. In addition to the stoppage of circulation in the water-pipes, overheating may be caused by a leak in these pipes, so that the water has all run out on to the road, or it may be due to an air-lock. In the first case the leak can often be temporarily stopped by a piece of rubber piping placed over it; in the second case the drain tap of the water system must be opened and the water all drained away, new water at the same time being poured in until the cold supply is flowing out of the drain-cock without interruption.

An equally common cause of overheating is improper lubrication. On the dashboard an automatic lubricator is usually fitted from which oil is driven into the cylinders either by a small pump driven mechanically by a belt, or by air pressure obtained from the exhaust pipe. In either case a sight feed is provided, and the driver must now and then look to see that the oil is dropping at the proper rate for efficient lubrication. If there is too much oil it will become carbonised in the cylinders, the exhaust valves will get choked up, and there will be a considerable loss of power. If there is too little oil the engine will overheat. The lower part of the crank case in a vertical petrol motor is designed to contain a certain amount of oil, into which the cranks dip at each revolution. This must be filled to the proper height with good lubricating oil, the exact amount varying from half a pint to a pint and a half, according to the size of the engine. If by any accident or negligence the drain taps at the bottom of the crank chamber should have been left open, the oil will, of course, drain away, and the big-ends will seize. Another cause of overheating—but it is more common with air-cooled than with water-cooled engines—is the use of too generous a throttle, by means of which more heat is generated by the explosions of the gas than can be absorbed by the cooling system. In all cases where overheating is suspected the compression taps at the top of the cylinders should be opened and a charge of paraffin oil injected by means of a small pump; and the engine should be allowed to stand until it is thoroughly cool.

Next to overheating, the carburettor is, on many cars, the greatest cause of anxiety. The engine may run spasmodically, now "pulling" with life and strength, at other times dropping to a very feeble impulse. This generally means that the supply of gas is being delivered to it intermittently, and the fault is more often than not in the carburettor. Sometimes a speck of dirt may have got in with the petrol and lodged in the nozzle of the spray; this ought to be impossible if proper care is taken to fill the petrol tank only through a strainer of very fine wire gauze. Or the float in the float chamber may have got jammed by the spindle attached to it having become bent, in which case it must be freed until it works easily and sensitively. Or perhaps the float itself, if of cork, has become sodden, or, if of metal, has sprung a leak. In the first case a new float must be fitted, in the second the hole must be found, the petrol emptied out of the float, and the leak stopped up again. Or the cause of a stoppage may be in the ignition; the accumulators may have run down, or the wires, being insufficiently insulated, may have caused a short circuit. Some of the terminals may have become connected by means of dirt or water, or the contacts may not be clean, or may be insufficiently screwed down. All such faults as these will in time occur, certainly to the careless, and probably even to the most careful and lucky motorists. They each contain their lesson, and it is nearly always the same: see that things are thoroughly in order before you start if you wish to avoid trouble on the road, and let the novice remember that the most probable causes of all stoppages are generally the simplest; that the most common reason why the engine will not start is that the petrol tap has not been opened, and that the most common fault of ignition is that the current has not been switched on.

To run a motor-car successfully throughout a long journey needs no less forethought and much more experience than are needed for short runs. Before starting for a long tour a list of things to be carried on the car should be carefully made out. If the tyres are in good condition it will be enough to carry one spare cover and two inner tubes, and the repairing outfit should be looked to to see that it is complete and in proper condition. An assortment of nuts and bolts of the various sizes used in the engine should also be carried, as well as four sparking plugs and

a complete set of valves and valve springs. I say a complete set of valves because, although there should be no trouble at all with the valves, anything which does happen—overheating or incrustation, for example—will be more likely to affect all the cylinders than only one. A set of brasses and a supply of insulated wire are useful "spares." Spanners to fit all the nuts should, of course, form part of the regular equipment of a car, as well as a Stillson's wrench and a monkey wrench. A small table-vice is a very useful thing to carry, and does not take up much room; there should also be files, punches, a hammer, screwdrivers, a cold chisel, gas pliers, and a soldering outfit. A good roll of copper and steel wire, a little copper piping, asbestos washers, a length of asbestos cord, and a couple of yards of india-rubber tubing of the same gauge as the pipes of the water system, must also be carried. These things will not take up very much room, and as most of them will not be wanted at all, they can be stowed well out of the way. A tin of paraffin should be carried with the lubricating oils, and a small reserve of carbide and wicks for the lamps should also be carried. These supplies should all be assembled together a day or two before the beginning of the journey, and arranged on the bench or floor of the motor-house, all the contents of the car being also taken out for inspection and, if necessary, replacement. They can then be checked off with the list and carefully packed away.

It is always a good plan to start on a journey early in the morning; why, I could not exactly say, except that it adds greatly to the enjoyment of the traveller; and besides, there is a proper time for all things, and the morning is the time to set forth on journeys. When everything is ready for the start the motorist should take a last look over his machine, making sure that all water tanks, petrol tanks, and grease cups are full. In very cold weather, and especially if the car is likely to be left standing for any time, 20 per cent. of pure glycerine should be added to the water in the cooling system; this will effectually prevent it from freezing. But this, of course, is only a winter precaution. It is well, however large the petrol tanks may be, to carry one spare tin of petrol, which should be kept as a reserve, and, if it is used at all, replaced at the first opportunity. Attention to this detail will mean that the motorist can never

be stranded ten miles from anywhere for want of petrol, but will always have enough to take him into some town or village where at least shelter will be procurable. When the engine is started it is well to let it run for a few minutes and to watch the working of the valve gear, pumps, lubricators, etc., to see if everything is in order, and, if necessary, to adjust the sight feeds of the drip lubricators. Then, and not till then, the motorist may mount to his place, release the brake, and move off. Even then the first few miles should always be devoted to seeing that the car is running properly, that all the control mechanism is in order, and, above all, that the brakes are working. This should always be the first thing to be tested on starting for a drive; and it will soon become a matter of habit if, on passing some point close to his own house or in his own grounds—some point that he always passes when he is starting out—the motorist makes it a rule to put down his clutch pedal and apply both brakes in turn. He will then be sure that they are in good condition and ready for the emergency in which that condition may be all-important.

There is no royal road to safety and immunity from accidents in motor-cars. Unceasing watchfulness is the only possible protection; and even this is useless unless it is allied with forethought, common-sense, and a decent unselfishness. It is perfectly safe for a competent driver to travel at very high speeds along many country roads even in England; only, however, because of the immense control which can be exercised over a good motor-car, and because it is possible in a few seconds to reduce a speed of fifty miles an hour to eight or ten, and to stop dead if necessary in a few yards. But it should hardly ever be necessary to stop dead, because in nine cases out of ten the driver's reason for doing so is that he has been taking a risk which he ought not to have taken and has been presuming on a state of affairs which did not exist. In driving at any speed other than a mere crawl the driver's eyes should be on the road in front of him and not on the front wheels of the car. The distance that he can see the road in front of him, as well as the condition of the traffic on the road, determines the speed at which he may safely travel. It is astonishing how quickly one's powers of observation, within the limited range necessary for the purpose, are developed by driving a motor-car. Every

motorist knows what it is to be accompanied by a somewhat nervous companion who insists on telling you of things that are in the way, which he fancies you may not have seen. As a matter of fact, you have seen them, mentally dealt with them, and put them out of your mind again, before the nervous passenger, for all that his eyes are strained on the road, has even noticed their presence. A cow is grazing fifty yards in front of you, a dog is stretching himself in the sun twenty yards in front of that, and a hen preparing to step across the road thirty yards away. Almost unconsciously the expert driver goes through a practically instantaneous mental process with regard to each of these objects. He decides that the cow means to stay where she is, but he has considered the possibility of her moving into the road, and has decided, still subconsciously, how he will act if she does. The dog and the hen are each subjected to a similar double process, one of which is concerned with probabilities, and the other with possibilities. So that long before he has reached them the driver knows what each will probably do, and has also instantaneously thought out all the other things which they may possibly do, and the various means which he would adopt to deal with such emergencies. And long before he has passed the cow, and the dog and the hen, his eyes have noticed a hundred other conditions and things beyond them.

Apply this to every inch and yard of road covered in a day's journey of 200 miles; add to it the observation of a great deal of scenery on a large scale, and you have an idea of the mental quickening and fine consonant training of eye and brain and hand that comes from driving a motor-car. Put the average speed up to sixty miles an hour and double the distance, and you have some idea of the splendid mental feat accomplished by a driver in a race such as the Paris-Vienna, or the Paris-Bordeaux. People speak of these contests as great trials of physical endurance; but it is really mental endurance of which they are the test, and it is through the mind that the body is exhausted in them.

For my part I should be sorry to drive all day long at such a speed that my eyes must be constantly fixed upon the road; and the wise motorist, when he is going on tour, will not plan a day's journey of more than a hundred or a hundred and fifty

miles, so that he may give himself time to see and enjoy something of the country through which he is to run. But when travelling at a high speed you must never be sure that the road is clear because there is nothing on it. The only absolutely safe road is that over a common, down, or moor, where the ground is flat on both sides of the road, and where all approaches to it are clearly visible. Where there are hedges things may come out from behind them; where there are side roads, sleepy cart-horses may be drawing sleepy carters in slow, heavy carts that are rumbling towards you and disaster. And you must never trust a horse. Man behind a horse is almost helpless; and though on catching sight of a motor-car he often does his best by his startled jerk at the reins to frighten the horse at your approach, it is only by the grace of the quadruped that he gets past you in safety. If the horse chooses to stand on end, to shy or to back when you are about to go past him, nothing that the occupant of the trap can do will modify or prevent his deadly purpose.

Side-slip, in spite of the various devices for its prevention that have been applied to pneumatic tyres, remains the chief anxiety and danger of motor driving. The tendency in a vehicle that is driven by means of its rear wheels, or is running down a hill by gravity, is for the rear (and heavier) part to try to overtake the front part. If the car is kept running in a geometrically straight line on a geometrically level road this tendency is frustrated, and side-slip becomes impossible. But at the moment when, because of a deflection of the steering gear or a slope in the surface of the road, the front and rear wheels cease to be on the same plane, it becomes possible for the rear part of the car to swing round sideways, provided the surface of the road is smooth and greasy enough to permit of lateral movement of the wheels upon it. The result is that if the car is travelling at any speed its direction is uncontrollable by the driver, and it swings right round and moves bodily sideways. This is a very alarming and dangerous occurrence; and although if the car is not travelling too fast skilful steering will check the lateral movement before it has gone too far, there is always a risk that some accident in the surface of the road or in the disposition of the surrounding traffic may cause catastrophe. The worst conditions for side-slip are found on hard

asphalt pavement after a slight shower of rain, or after heavy rain when the surface of the road has become partially dried. A greasy film then covers the road and coats the tyre, and between the two greasy surfaces thus formed there is no possibility of grip or bite. Wood pavement under the same conditions is almost equally bad; and after it, in the order of danger, come ice and chalk roads.

There is nothing to be done when these conditions are encountered but to drive very slowly and steer very cautiously, as a sudden deflection of the steering or application of the brakes will almost certainly cause a side-slip. If this should occur, the clutch should at once be withdrawn and the steering wheel firmly and sharply manipulated so as to correct the lateral movement; but if (as so often happens with cars with a short wheel base and high centre of gravity) the lateral movement continues, it is better to let the car swing right round on the front wheels as on a pivot, as the car can by that means be more or less kept in one part of the road. Cars which have a long wheel base are much more easily controlled when they threaten to side-slip, as the movement is felt long before it has become excessive. Perhaps the best way to learn how to avoid side-slip is to learn to side-slip properly—that is, if an empty greasy road can be found and the services of some competent motorist who has done it before secured. It is possible for expert drivers to turn their cars either half round or completely round under these conditions with perfect safety and to arrest the turning movement at any point that may be desired. But as I have said, the best use of these somewhat heroic studies will be to teach the motorist how to avoid side-slip. It is a matter that requires constant watching, for on a long day's journey one may encounter many conditions of weather and many kinds of road surface; and there are many places in Derbyshire, for example, where one may be running on a hard dry road one minute, and the next, on running beneath the shade of heavy trees, find oneself amid the very worst conditions of greasy and chalky surface. As in so many other matters connected with motoring, the most watchful and careful driving is the only safeguard.

I am almost ashamed to have to add to this chapter a plea for common decency and humanity; and yet no one who uses

the roads, whether with horse, bicycle, motor-car, or on foot, can pretend that it is not necessary, and that it has not been left to the motor-car to evolve the most blatant, the most cruel, the most revolting kind of selfishness that has probably ever been allowed to go unpunished. The motoring cad is the real enemy of motoring. It is not the nervous old lady or the testy old gentleman, it is not the small farmer or the conservative squire, who are responsible for our motor laws and for the enmity of the police. It is the motorist himself, the man who frightens the timid old lady, annoys the testy old gentleman, infuriates the farmer and squire alike. No advice that I can give will abate the nuisance of these people; it is their nature to be offensive, and unhappily the motor-car endows them with almost unlimited opportunities of indulging themselves. But there are others in whom mere thoughtlessness and perhaps a little of the intoxication that, in some people, springs from the control of power and speed, have bred a disregard for other people that is only less unpleasant than the ways of the motor hooligan. To such people I would repeat what has been so often urged in other places: remember that you are not the only users of the road; remember that you did not always own a motor-car; remember that you were once, perhaps, capable of enjoying a quiet walk on a country road; and that on those occasions what made you happy was the quietness and peacefulness of the country, the smell of the flowers, the song of the birds. Remember that if you whoop through a village at thirty miles an hour some Sunday morning in the summer time and meet a crowd of decent villagers going to church, the clouds of dust that you raise may spoil their Sunday clothes, fill their mouths with grit and their hearts with bitterness. And remember that it is open to you, if you have neither consideration nor conscience, to leave behind you as you go a trail of dislike and anger, a track of unpleasant thoughts and scowling faces, little monuments of discontent that shall mark your way like milestones. And above all—I am ashamed to have to say it—have mercy upon timid women, dogs, and little children. If you have no imagination you will have no idea of the horrors of apprehension suffered by many a woman alone in a pony trap who sees your approach and does not know whether you mean to stop or not; but take my word for

it. If she makes a sign, hold up your hand to show that you have seen it and go past her (it may not be necessary to stop) as quietly as possible. The only thing you need have little mercy on is the unattended horse dozing in the empty village street. Frighten him, if you like, and chivy him far away from the place of inattention; he is a scourge and a danger; but he will take good care not to hurt himself. And people who have to pay for many sets of broken harness will soon learn not to leave their horses unattended.

If you are threatened by a dog, go slowly; he may be a senseless, ill-conditioned, barking cur, but he has a right to his life; and besides, you may be seriously hurt yourself if you run over him. But even upon the little dog have some mercy; for if you are a person of any decency and humanity, that cannot be a happy or successful day's journey for you upon which you have killed a dog. And as for children, remember that their minds work in ways that we know not, that our dull senses are no guide to their actions, and that if it seems good to them to play at "last across," you had better go very gingerly in their neighbourhood. In a little while a new generation of children will grow up, wary of motor-cars, and trained, poor mites, in the taking of cover; but in the meantime remember that the bit of village street through which you flash on your hundred-mile journey is their life, and contains for them all the sunshine, all the dangers, all the pleasures and toils of life.

CHAPTER X

THE CARE OF A MOTOR-CAR

The ill-attended car—Caring for machinery—Good and bad servants—Being one's own mechanic—The rewards of labour—Expert instruction—The essentials of a motor-house—Occupation for a wet day—The ideal motor-house—The motor-pit—Drainage—Mechanic's bench—The keeping of spare parts—Storing petrol—Hot weather—Proper condition of a motor-car—The abuse of the sponge—Filling and lubricating—Grinding valves—Accumulators and charging—The care of tyres—Treatment of new cars—The annual overhaul.

IT would be hard to estimate how much of the utility of a motor-car depends upon the care that is taken of it, and the attention that it receives in the motor-house. An ordinary well-constructed motor-car will run with comparatively little attention, and its behaviour on the road may not for a time seem to be very much different whether much or little time is spent on it when it is standing; but it will not be long before the results of care or neglect begin to show themselves. In the one case the car will continue to do its work punctually and easily, and repairs and renewals will be comparatively trifling; in the other things will after a short time begin to go wrong suddenly and incurably, with the result that expensive repairs and replacements will be necessary before it can be used again. There can be no difference of opinion as to which of these conditions is the more desirable, and it depends upon the individual motorist, much more than on the individual motor-car, which condition obtains in any given case. There are a great many people who think that a motor-car should not need any attention at all, and that the time which has to be spent in attending to it when it is not in use involves a reflection on its manufacture or design. Such a view is, of course, extremely unreasonable. The most efficient machinery is but a device for supplementing

and economising the labour of man; and no machinery in the world is a complete substitute for labour. But with the use of machinery so much greater a result can be secured for a given outlay of labour that its use is an obvious economy.

The motorist, therefore, who desires to get the maximum of pleasure and utility from his motor-car will realise from the outset that a certain amount of time must be devoted to it in return for the services which it renders to him. Whether that time and labour are expended by himself or by a hired motor-man, they are equally necessary; but the more they are devoted as a labour of love, the better the results will be. One of the first questions which the motorist will have to decide, therefore, is whether he is content to look after his car himself or keep a motor-man for the purpose. Both systems have their advantages, but much depends on the uncertain element contained in the persons of the prospective owner and mechanic. There is no luxury like that of a good servant whose work is a pleasure to him and who takes both pride and interest in doing it as well as possible. But there is another and, I fear, a larger class of servants who are merely hirelings, who regard their working hours as a bondage, and who lose no opportunity of curtailing them as much as possible. Such a servant, far from being a luxury, is a trouble and a nuisance, and the relationship between him and his master is degrading to both.

If one has the necessary time and any taste for machinery at all it is far better and pleasanter to be one's own mechanic. There is then a personal relationship between the machine and oneself which, however fantastic it may seem, is really an undeniable factor in securing satisfactory results. For the millionaire, of course, things are very simple; his stud of motor-cars is attended by a set of the best and most experienced men that money can procure; and in such a case the owner has nothing to do but make an occasional survey of his motor-houses. But I have seen more than one such man whose cars were brought round to him at the appointed hours in the pink of condition and in a perfection of polish and spotlessness, and who had nothing to do but take his seat, grasp the steering wheel, and set off on a journey of any length, relinquishing all thoughts or concern when he stepped from the car; and I have seen another man who knew the

condition of every rod, bolt, and valve in the car, because he had adjusted and tested them himself, who knew exactly what was happening in every part of the machine, because he had for a certain number of hours become oily and grimy in its service; and I know which of the two was the happier and derived the greater pleasure and satisfaction from the knowledge that his machine was running well.

The most satisfactory, and by far the most economical, arrangement for motorists who can spare the necessary time is for the car to be washed and cleaned by some man on the premises, and for the owner himself to undertake the care of the machinery, with occasional expert assistance in the case of some complicated replacement such as is involved in the taking down and renewal of gears. It is absolutely essential, however, that the motorist who proposes to be his own mechanic should not be content with a merely superficial knowledge of "how the thing works," but should make himself thoroughly master of the construction of his machine and the working of all its parts before he takes charge of it. It is not at all a bad plan for such a motorist to hire from the makers of his car one of their mechanics for a few weeks at the beginning of his motoring career. Such a man will, in nearly every case, be quite willing to explain matters to the novice, who should be allowed to make adjustments under his supervision. He will then have a feeling of much greater confidence, when the time comes to deal with an emergency, than he would otherwise have had.

The housing of a motor-car is an important matter and has much to do with the condition in which it is kept. Any damp or dirty shed will not do for the purpose. An ordinary coach-house, with a few adaptations, makes quite a suitable motor-house, the great essential being that it should be dry, well ventilated, and well lighted. Dry, because damp is always an enemy to delicate machinery and carriage work; well ventilated, because in the event of a petrol leak there must be ample means of escape for the fumes; and well lighted, because the motor-car that is kept in a dark house cannot be thoroughly examined or cleaned. There are worse occupations on a wet and stormy day for a man who cares for his motor-car than to don a suit of overalls and, repairing to the motor-house, give

his car a thorough examination, adjusting what requires adjustment, renewing what needs renewing, and generally performing the hundred and one odds and ends of work that have been postponed for just such an occasion. If the motor-house is well lighted, this will be a pleasant and absorbing task, and it will probably be well done; but if the motor-house is dark, it will be a dismal occupation indeed. Either the doors will have to be left open, admitting rain and wind, or the motorist will spend his time in an oily twilight, working as much by feel as by sight, guessing what he does not see, and neglecting what he does not guess.

If a motor-house is to be specially constructed it may either be built of brick or stone, or a very efficient though less sightly building may be constructed of corrugated iron and wood. This will, of course, be much the cheaper of the two. But if an ideal motor-house is desired it should be substantially built, with a deeply pitched roof containing large skylights. The floor should be either of concrete or of the tiles commonly used in the flooring of stables. In the middle of the house a motor-pit should be sunk, about 5 feet in depth by 6 feet in length, and about 3 feet 6 inches in width. Stairs should be constructed at one end of this, and it should be fitted at about an inch below its edge all round with a slightly projecting ledge on which strong covering boards can rest, closing in the pit when it is not in use. Lower down, at about three feet from the floor, another ledge should be fitted to carry a sliding seat, which also can be used as a shelf or table for tools. If electric light is used, there should either be a plug fitted in the pit or two or three brackets should be fixed to the walls on which portable lamps can be hung. The pit should be well drained, otherwise it will soon contain an accumulation of grease and dirt.

In such a house the floor should slope slightly from the centre where the pit is to a gutter surrounding the floor close to the walls, *but containing no grids.* Oil blocks drains, and petrol is a great danger in them; all droppings from the car should therefore be wiped up. The slope of the floor will prevent the droppings of oil and cleaning material from the car running down to the pit, where their presence would be far from desirable. Outside the motor-house and immediately in front of it should be a well-drained pavement for washing cars, and this, if

cost is not of great importance, should be protected by a glass roof carried on brackets from the front of the motor-house. In this case the pit might with advantage be situated outside the motor-house and under the glass roof. Inside the motor-house itself a small bench fitted with a vice will be found extremely useful, and there should be ample accommodation in the way of shelves and cupboards for such things as cleaning cloths, grease, lubricating oils, carbide for the lamps, lamp-wicks, spare nuts, bolts, and valves, sparking plugs, wires, batteries, and so forth. Petrol and paraffin oil should be kept in a separate building; the roughest little cabin will do so long as it is thoroughly ventilated; but these stores should on no account be kept in any building adjoining either motor-house, stables, harness-room, or the living-rooms of the servants. If petrol is stored in the ordinary two-gallon tins any rough out-house that can be locked up will serve the purpose; but if it is desired to store petrol in bulk special tanks will have to be constructed and a special licence obtained. Perhaps the best plan in such circumstances is to have one or more galvanised iron tanks sunk in the ground and fitted with a pump and a float for indicating the level. Many other ways will suggest themselves in which safety can be assured. Sir David Salomons, for example, whose motor-houses at Broomhill, Tunbridge Wells, are probably the most completely equipped in this country, has devised a special house for the storage of petrol built of bricks with slight gaps in between so as to allow a free current of air to pass through them. The roof is of corrugated iron and the floor of concrete; the petrol-tanks are placed on sills of such a height that if they were to leak their whole contents could run out on to the floor of the house without escaping outside it; and this floor space below the sills is almost entirely filled with sand which would absorb the escaping liquid. But with the present facilities for obtaining petrol at short notice few motorists would find it necessary to store it in such large quantities.

Suitable brackets, somewhat similar to those on which saddles are kept, should be provided for tyre covers and spare tubes, the latter being very slightly inflated before being hung up. It is better, however, to lay tyres on their sides in a clean, dry, and cool place with a sheet of very coarse canvas between each tyre, so that air can circulate completely round them. Bins

should be kept for clean and soiled cotton waste, and two smaller bins containing sand and sawdust respectively should also stand in the motor-house. The sand is for the extinction of any petrol fire that should by accident arise, as water is useless for such a purpose; and the sawdust should be thrown on the floor where any heavy oil has dropped; it will absorb the oil and can afterwards be brushed up. If oil is dropped on the floor and is not treated in this way, it will be certain sooner or later to find its way to the tyres.

Unless the motor-house is part of a warmed building it will probably be necessary to provide artificial heat in winter and in very wet weather. This should on no account take the form of a lamp or fire inside the house itself. Where an electric current is available an electric stove is by far the best apparatus for warming a motor-house; but it is expensive. The next best thing is an apparatus of hot-water pipes, the boiler being situated in a compartment of its own outside the motor-house. An alternative would be a hot-air system, the heat being supplied by a large paraffin stove, also placed in a special compartment outside the motor-house. The temperature should be kept at about 50° Fahrenheit.

If the motor-house is properly warmed there will be no need for waterproof covers for the car, but it should always be covered with a light dust cover except in very damp weather, when it is better to use no cover at all. If top lights are used as I advised, they should be fitted with roller blinds, so that in hot weather the direct rays of the sun will not beat upon the car. One or more chemical fire extinguishers should be part of the equipment of every motor-house, as in the event of a flare of petrol the car itself may take fire, when it would not be advisable to use sand as an extinguisher. If the car is to be in the motor-house for several days at a time, it is always well for the sake of the tyres to jack all four wheels up off the floor. For this purpose four stout wooden supports should be made, each with a cross piece at the bottom to serve as a foot and a groove cut in the top and faced with leather upon which the axles may rest. Each wheel of the car should then be jacked up in turn and one of the wooden props placed under the axle at each of the four points of suspension. The foot of the prop should, of course, be placed logitudinally with the car.

The foregoing suggestions, although they apply to a motor-house on a somewhat luxurious scale, may easily be adapted to suit the purpose of a very modest establishment indeed, the great essentials of a motor-house being dryness and ventilation. But whether the motor-house is built of palatial stone or corrugated iron its dimensions should at the very least permit of an easy passage right round the car, so that no gymnastic performances are necessary in the cleaning of it.

With regard to the care of the car itself, that consists in leaving it in a condition to be ready to start on a journey of any length at a few minutes' notice; and this can only be accomplished by regular attention in every detail. When a motor-car comes in from a day's run in wet weather it is convenient to get the loose mud off it at once, as there is a danger of its scratching the paint if it is left on to dry. Now the wise owner who takes a pride in the appearance of his carriage work permits only one method of washing in his stables—water and chamois leather. The use of the sponge, which is commonly advocated, certainly expedites matters, but in the end it damages the paint work. The ideal method is to use a hose pipe with a narrow nozzle and to remove dirt by the flow of water alone, afterwards drying and polishing with wash-leathers. If a motorist can induce his cleaner to adopt this slow but excellent method, he will be rewarded by shining paint work and a low bill at the varnisher's. In very obstinate cases a mixture consisting of a bucket of soft water and a teacupful of petrol may be syringed on to the soiled paint; but it must afterwards be cleaned and polished with boiled linseed oil. The use of the hose, however, is not so simple a matter on a motor-car as it is on a carriage, as great care must be taken not to splash the water indiscriminately about the under frame and to keep it absolutely clear of the engine. If the bonnet is easily detachable, it may be taken off altogether and the hose played upon it; otherwise it will have to be sponged.

The use of the water-brush on the carriage varnish must be absolutely forbidden; it should only be used on the tyres and on such parts of the under frame as collect hard caked mud. If the hose is used when the car comes in, it should only be used sufficiently to remove the loose mud, the actual cleaning being postponed until the engine has cooled down. It should

then be cleaned in the usual way, the final polishing being reserved until the engine and all the running gear have been cleaned. The best way to clean the engine is with paraffin applied with an ordinary paint-brush and afterwards wiped over with waste.

Unprotected chains, if they are only a little dusty, may be cleaned with a paraffin brush and afterwards brushed over with tallow and blacklead; but if the car has had a long and muddy journey, the chains should be taken off and laid in a shallow pan containing petrol or paraffin oil. The best way is to put them first in petrol and shake them about in it, and then leave them all night in a tray of paraffin. After that they should be lubricated either with melted tallow or some of the special preparations of graphite and grease which are sold for the purpose. This should be allowed to penetrate well between the links, when the chain may be replaced. When the engine has been running for some time a good deal of oil will have worked its way along the various shafts and bearings; this should all be wiped away, and all exposed motion cleaned with oily waste. The taps at the bottom of the crank chambers should periodically be opened and the cylinder oil allowed to drain away; it is then a good plan to inject paraffin through the compression taps at the top of the cylinder and to turn the engine by hand until it has all run through and out of the crank chamber. In the same way all open bearings and oil cups should be filled first with petrol and then with paraffin, and the motion turned until it has all worked out, when the lubricators should again be filled with lubricating oil and the engine run for a few minutes to let the oil work into the bearings. The less the amateur opens up the engine and other parts of the machinery the better; and all uncouplings, disconnections, and unscrewings, except for a necessary and definite purpose, should be strictly avoided. If an engine is running well it should be let alone; for while the amateur finds machinery easy enough to take to pieces, it does not follow that he will be able to put it together again so easily. And there is always the danger that he may leave a spanner in the crank chamber or a washer beneath the valve cover, and spend a long time hunting for them, and have no idea of where they are until he starts the engine—if, indeed, he guesses then.

A car that is running in good order should need little in the way of attention except in the exhaust valves, which, especially at first and in a car driven by an inexperienced driver, would periodically become choked either with the waste of decomposed lubricating oil—a result of over-lubrication, overheating, and improperly regulated mixture—or the valves and their seats will have become pitted by the same agencies. In this case they will require regrinding—not a difficult matter. The covering of the valve chamber having been taken off and the springs of the valve removed, its bearing surface and its seat must be wiped clean with paraffin or petrol. A paste should then be made of emery flour and fine lubricating oil, and the bearing surface of the valve coated with a thin layer of this substance. The valve should then be replaced in its seat, care being taken to turn the engine so that the striking rod from the cam-shaft clears the stem of the valve, which should bed firmly on its seat. A brace screw-driver should now be placed in the slot cut in the valve, which should be twisted round about on its seat in both directions, moderate pressure being brought to bear on the brace. When this has been done for a few minutes the valve should be removed, the paste rubbed off it and the seat, and a little more applied with the finger, when the same process should be repeated, the valve being turned round in a different position. The valve and its seating should now be examined to see whether the surface is bright and true; if it is not, the process must be repeated until every sign of pitting has disappeared. Before replacing the valve it and its seat must be scrupulously cleaned with several clean fragments of oily waste, one being used after the other and then thrown away, as nothing could be more disastrous than for any fragment of the emery paste to get into the valve chamber and so into the cylinder. The valves and valve mechanism may then be replaced.

Sparking plugs, wires, and all electrical apparatus will need regular examination, the insulation of high-tension wires being a particularly vital matter. Where accumulators are used at least two sets should always be kept, one fully charged ready to replace the one partially discharged. If there are facilities for recharging in the motor-house itself—and this is a simple matter where electric light is installed—it is not a bad plan always to set out for a day's run with fully charged accumula-

tors, as however little an accumulator may have been discharged, its life is greatly prolonged if it is not run down too much before being recharged. It is usual to carry an additional accumulator on the car itself which can be switched on in case the one in use should fail; and this spare accumulator should be regularly examined and tested like the others with a voltmeter. The water for cooling should periodically be drained away and the tank refilled with soft water poured through a strainer. In refilling, the drain-cock of the water system should be left open until the new water begins to flow freely out of it, so as to avoid an air-lock. This is necessary whether the water circulation is maintained by pump or on the thermo-syphon system. It goes without saying that all grease cups and lubricators should regularly be filled up whenever the car is in the motor-house, and that the gear-case should not be allowed to run too long without being filled with new grease. The grease caps on the wheels are apt to escape attention; but these should be kept well filled with a mixture of gear grease and oil, or with pure vaseline.

These remarks as to care and cleaning apply equally to steam and petrol cars. In the case of a steam car which has a fire-tube boiler of the old type, this should be blown down at the end of every day's run, the blow-off cock being opened slightly at first and fully when the steam pressure has fallen to about a hundred pounds. When the boiler has blown itself out all taps, including those on the water column, should be opened and the water supply from the tank shut off so that the air has access to the boiler, which can then neither syphon itself full nor form a vacuum. There is danger if the boiler is allowed to syphon itself full that the water will penetrate into the throttle and thence possibly into the engine, through which it will have to be worked when the car starts. In all steam cars regularly used it is just as well, even when there is no danger of frost, to open all the drain-cocks and drain all the water and steam away; on the other hand, if they are to be left standing for any time in temperate weather they should be filled up with water, so that rust cannot form.

When there is nothing else to be done to a motor-car there is nearly always something that can be done to the tyres. Any spot of oil which may accidentally have got upon them should

be carefully removed with benzine, and all little cuts in the covers, however smooth, should be filled up. It is a very good occupation for a wet day, when the car is not to be used, to go completely over the tyres, plugging small cuts in the covers (after they have been carefully cleaned out with sand-paper) with rubber solution and scraps of unvulcanised rubber, the wound thus healed being covered with a rubber bandage to keep it from the air. There is nothing in which so great an economy can be effected by a little attention now and then as in the care of pneumatic tyres, which are among the most expensive, as they are certainly the most vulnerable, parts of a motor-car.

Cars that come new from the factory require special attention in the motor-house, as some of the bolts and nuts are almost certain to work loose during the first few runs. These should be gone over carefully with a spanner; the one that is missed will probably be the loose one. New cars should also be heavily lubricated, even at the cost of dirty valves and an unclean exhaust; but they must be all the more scrupulously cleaned, both inside and out, on this account. With regard to general overhaul, I am convinced that it is a practical economy to send a car that is in daily use once a year to the works to be taken to pieces and examined, and all worn parts replaced. The makers would, in most cases, give an estimate (which should not be heavy) for the taking to pieces and rebuilding; they would then report what replacements were necessary to make the car as good as new. The average annual mileage of a small car in constant use would be about 5,000 miles, and of a large touring car 10,000; and after such a piece of work a complete overhaul is not an unreasonable suggestion. Moreover by this means the motorist has his car annually renewed, and need not feel that the value of it is being wiped out by depreciation.

CHAPTER XI

CONCERNING TYRES

A bane and a blessing—The motorist's chief anxiety—Who is to blame?—Tyres too small—Care in driving—Solid tyres—Construction of the pneumatic tyre—The use of protecting bands—Cushion tyres—The Palmer Cord tyre—Spare tubes and covers—The storage of pneumatic tyres—Temporary repairs—How to attach and detach pneumatic tyres—Patches and plasters—Punctures and side-slips—The Parsons and other devices—Nail-catchers.

IT is not too much to say that the motor-car in its present form and in its present state of efficiency would be impossible if the pneumatic tyre had not been invented. In the early days of the steam carriages one of the constant problems presenting themselves to the designers was how to avoid the damage and disintegration of the machinery caused by the shocks transmitted through the wheels from the surface of the road. In railway work this problem is not present, or it is present only in a very modified degree; but in vehicles designed to travel on the common roads it is a very serious one. And serious as it was in the case of the steam carriages requiring machinery very heavy and solid in proportion to the work it had to do, the difficulty becomes acute when we are dealing with the very light, delicate, and fast-running machinery of the modern motor-car. The invention of the pneumatic tyre has made it possible to use this light and comparatively fragile machinery on motor-cars; but it has brought in a new crop of difficulties in the form of its own perishable nature, its costliness, and its liability to puncture and other forms of sudden damage. And as it stands to-day, the pneumatic tyre is curiously enough at once the great boon and bane of motoring—a boon because it makes speed and luxuriously smooth progress possible on the common road, a bane because it is, compared with the other wearing parts of the machine, so fragile and so costly.

There can be no doubt that to many a man weighing in his mind the pros and cons of investing in a motor-car, the tyre trouble, with its unknown quantity of expenditure, seems like the last straw that broke the camel's back. Other matters can be estimated for with some accuracy; the life of any part of the machinery is approximately known, the cost of petrol, of repairs, of cleaning and lubricating, can be pretty accurately forecasted. But no one knows the day nor the hour when his costly new pneumatic tyres may burst asunder, or be cut or ripped to pieces by some evil accident. Insurance companies will provide at very moderate cost freedom from anxiety as regards all other damage; but they will not insure pneumatic tyres. So that the pneumatic tyre, although it cannot well be dispensed with, constitutes undoubtedly one of the gravest anxieties of the motorist. One is compelled to ask, therefore, what the cause of this apparent failure is; whether it is that the manufacturers are unable to produce a tyre equal to the work demanded of it, or whether there is some widespread carelessness in the use of the tyres that causes them to give so much dissatisfaction and anxiety.

A few years ago one would have been compelled to attribute the blame almost solely to the manufacturers. Like everything else, the idea of the pneumatic tyre was some time in advance of its realisation; but the demand for it was so urgent that people began to make pneumatic tyres without having given sufficient time to the study of their proper construction. They were often flimsy and badly constructed; and the materials used were not of that superlative quality which seems absolutely essential in manufacturing processes where india-rubber is used. So that tyres were constantly failing, and could never be relied upon.

Now, however, I am inclined to think that the blame has shifted to the other shoulders; that although first-rate pneumatic tyres are now available, they are so misused and neglected by the average motor-car owner that the troubles connected with them are more often his fault than the makers'. But why make things so delicate as to require constant attention? the user may ask; and in that case I have nothing to say to him but to remind him that we are neither in Utopia nor in Paradise, but in a vale of tears where perfection is seldom attained and

where, even as regards motor-cars, the best within our reach is a mixture of pleasures and pains. It is surely something to the good that as regards pneumatic tyres we have at least attained something like a respectable degree of endurance and safety; and that, the manufacturer having so far done his part, it behoves the user at least to do his share in contributing towards an ideal condition of his wheels.

There is indeed a third party to the tyre question, and one by no means free from blame. I refer to the maker and seller of motor-cars, who, in his anxiety for speed and lightness and cheapness, habitually fits to the cars which he sells tyres of too small a diameter to sustain properly the weight and wear imposed upon them. The keen competition in the motor industry requires the maker to cut down the cost to the very lowest point; and as a motor-car is a machine composed of an enormous number of parts, very few of which are very costly in themselves or admit of much economy if the machine is to run at all, the maker has only a few expensive accessories by the cutting down of which he may increase his profit. The chief of these are tyres, which at their cheapest are an expensive part of a motor-car, costing anything from £20 to £150 a set. By fitting a size smaller than is required the maker can always save a few pounds, and at the same time add to the light and elegant appearance of his machine. This has been done to such an extent that even the standard ideas as to what is a proper weight and diameter of tyre for a given purpose have become affected by it; and in almost all cars, even in those the makers of which are beyond suspicion of scamping, the user would find it a benefit to insist on having tyres one size larger than the makers think it necessary to fit. I may seem to have harped overmuch on this theme throughout these pages; but I insist upon it, because I am convinced, not from my own experience alone, but from that of the users of every kind of motor-car and pneumatic tyre, that at least half the trouble and cost of up-keep associated with pneumatic tyres is due to this tendency to use tyres of too small a build.

To go back, however, to the troubles arising directly from misuse and neglect. Too many motorists, having started their engines at the beginning of a run, think that they should be able to reach the end of it without giving a thought to the

mechanism which is carrying them, or trying to protect it from some of the cruelties of the road; and too many, when they bring their cars in at the end of a journey, think that all that mechanism should require until it is started again is a douche from a hose-pipe and a pint or two of lubricating oil. The ways in which a careful driver can save his tyres on the road are many, and have already been referred to; so have the methods of looking after them while the car is not in use; and if the results attributable to neglect of this care are carefully considered, it will be seen that there is some justice in my theory that tyre troubles are more often due to the motorist's than to the maker's negligence. Punctures and cuts will, however, even with the best of care, sometimes occur; they may then be described, in insurance phraseology, as the Act of God, and the motorist, although he will have to pay, need not blame himself or the manufacturer. But with the use of proper protecting bands and of large tyres pumped up hard, and with the additional safety afforded by thorn and nail catchers, it is astonishing over how many thousands of miles of hard flint and granite the soft rubber will travel without being damaged.

Solid rubber tyres have many advantages, the chief being, of course, their cheapness and immunity from puncture troubles. Their chief disadvantages are that they are less comfortable than pneumatics, communicate more vibration and wear to the engines and running gear, and are useless for vehicles travelling at speeds above twenty miles per hour. Not being like pneumatic tyres, in a high state of distension, and consequently of grip upon the circumference of the wheel, the centrifugal tendency developed in a wheel revolving at a high speed causes them to creep upon the rim and to endeavour to fly off it altogether. For motorists, however, who are content with an average speed of fifteen miles an hour and who will forego a certain amount of luxury, there is a great economy attainable in the use of solid tyres on the driving wheels, where the wear is greatest and where most of the troubles with pneumatic tyres occur. If pneumatic tyres are fitted to the front wheels the engine will be protected from the worst of the road vibration; and with that reflection the economical passenger may cheer himself when he sits jolting in the tonneau. Moreover, the doctor will tell him that it is good for his liver.

Solid tyres are not popular, however, with the ordinary motorist, who very naturally wishes to get the greatest possible speed and comfort out of his car. There are several varieties of pneumatic tyre, most of them conforming to one principle of design. In this the outer part of the pneumatic tyre is a thick rubber tread, into the fabric of which several layers of canvas are built, the inside of it being lined entirely with canvas. This outer tread is in the form of a half tube, the concave rim of the wheel taking the place of the other half. Between these two is an endless tube of india-rubber of approximately the same diameter as the rim of the wheel; it is fitted at a point in its inside circumference with a metal air valve which projects through an aperture in the rim of the wheel. The outer cover fits on to this rim either by means of flanged edges, which engage with corresponding flanges in the rim, by wires and clamps (as in the Collier tyre), or by some other means. When the tube and cover are both in place (the wheel of the car being jacked up from the ground for that purpose) the air chamber is inflated by means of a pump, and expanding against the unelastic outer cover, forces that outwards from the rim until the whole tyre is hard. A cushion of compressed air is thus provided between the road and the wheel proper.

The best-known tyres in this country are the Dunlop, the Clipper Continental, the Clipper Michelin, the Collier, and the Palmer Cord, each of which has won many successes in the various races and reliability trials. All of these tyres are similar in principle, although they vary in structural details; and it would be very hard to say which is the best of them. The differences are chiefly in the manner of attaching the outer cover to the rim, and to some extent also in the sectional construction of the outer cover itself. The tread, as that part of the tyre which comes in contact with the road surface is called, is also variously designed; it may either be perfectly plain, or be moulded into transverse or longitudinal corrugations, or be studded with small projections—in each case to increase the grip on the road and to lessen the danger of side-slip. For the same purpose various bands are fitted over the tyre, in some cases of leather studded with metal, in others of rubber with a specially prepared surface. For my part, I would always

advise that tyres of four-inch diameter and under should be fitted with some form of band from the very beginning when they are new. Such treatment, which is not costly, adds much to the strength and life of the tyre, and takes very little from its speed. And while we are on the subject of speed, it may be observed that although a light tyre may add a few miles per hour to the speed of one's car, that advantage is soon wiped out by the time spent in wayside repairs ; and that it is better to spend one's time travelling along the road than wrestling by the wayside with a stiff and unkind outer cover. There are some single-tube pneumatic tyres in which the whole of the fabric is constructed in one piece—an endless tube with very thick walls attached to the rim by means of bolts fastened to the inside circumference of the tyre and passing through the rim of the wheel. On very light cars these tyres sometimes give very good results ; I have known Diamond tyres of this construction to last for many thousands of miles when protected by an outer band. Their almost unique disadvantage is that they cannot be properly repaired by amateurs, in spite of the ingenious equipment provided for that purpose ; but on the other hand their walls are so thick that in the event of a puncture the car can be run home on a deflated tyre without very serious consequences. But they are only useful for very light cars which manœuvre within a reasonable distance of home and help.

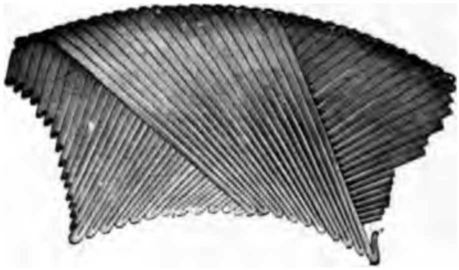
Some forms of cushion tyre have been introduced for motor-cars, the principle of which is a single rubber tyre containing a hollow core of air not under compression ; and in this way somewhat more resiliency is secured than is possible with solid tyres. One of the best of these is the Ducasble, manufactured by the North British Rubber Company. The tread of this tyre is wide and flat, and as the rubber is manufactured in a state of compression, any cut or puncture is automatically closed up by the expansion of the surrounding fabric. The method of attaching this tyre to the rim is particularly strong and rigid, so that the stripping of the tyre from the wheel is almost impossible.

The Palmer Cord Motor Tyre is one of the latest forms of the pneumatic tyre. Unlike every other pneumatic tyre on the market, it contains no canvas in the fabric of the outer cover. Instead of this, a fabric of what the makers call "airless cord"

is used. This is a cord composed of threads which have been first dried and then impregnated with rubber by special machinery; and the cord, which is composed of a great number of strands of the thread, is itself mixed and impregnated with pure rubber. By various methods of building and twisting up, every thread in the cord is absolutely insulated from every other thread by india-rubber, and a cord is thus made composed entirely of rubber and thread, from which the air has been expelled. This cord is closely wound on a mould the shape of the outer cover; two layers of it form the inner or restraining lining of the cover. Between this fabric and the rubber tread an endless belt of threads is embedded in the rubber in such a way as to prevent the undue spreading of the thick rubber tread when it is in contact with the road. Just outside this belt is embedded a thin strip of red rubber; and when the rubber of the tread becomes worn down so that this red strip is visible, the user knows that it is time to have his tyre sent to the works to be retreaded. All these components are vulcanised into one fabric, and as no air whatever is contained in the cord such as is retained by canvas strips, the tyre is practically impervious to moisture and rot. The makers claim that they can easily repair the tyre by taking away some of the damaged cords, inserting new ones, and vulcanising the whole. The remarkable success of a set of Palmer Cord tyres in the 1904 English Eliminating Trials for the Gordon-Bennett Race is a proof of the wearing and puncture-resisting qualities of this tyre.

Every motorist should learn how to repair his pneumatic tyres, as he never knows when a puncture may find him without a spare tube, and far from the reach of any help. As a matter of ordinary precaution two spare tubes should always be carried and one spare cover, a chamber for the storage of which can always be contrived by means of a false floor in the tonneau of the car. The habit of carrying spare covers lashed to the rear of the car like life-buoys is not only very ugly, but is far from good for the tyre itself.

The original equipment of a motor-car should therefore be six complete tyres. This may seem extravagant, but like so many other matters of initial outlay, it means economy in running expenses. The reason for having two spare covers is that the car may always be equipped with one perfect spare cover. For



FABRIC OF THE PALMER CORD TYRE

SHOWING METHOD OF CONSTRUCTION WITH FLATTENED CORD

THE PALMER CORD TYRE AND RIM

example, if a bad burst or cut occurs, the spare cover carried in the car should be put on, and the damaged one sent away to be repaired. The second spare cover should then be carried in the car until the repaired one comes back, when it may be carried as a spare one, and the unused cover returned to the store. If this simple rule be observed the motorist will never find himself without a spare cover, and he will also find that the life of his tyres is prolonged. It is a very good plan thus to give pneumatic tyres an occasional "rest"; and the mileage of which a tyre that is occasionally laid by is capable is greatly in excess of that of a tyre used continuously.

In storing pneumatic tyres it should be remembered that sunshine, heat, damp, and oil are their greatest enemies. They should be laid on their sides in a dry, cool place, and in a dim light; they should be covered with canvas, and the inner tubes should be given a little air, just one or two strokes of the pump, in order to keep them from kinking or sticking. The best way to carry spare tubes on the car is in a small india-rubber bag such as most pneumatic tyre manufacturers supply for the purpose. They should be carefully folded in this, or else laid lengthways in one of the side baskets of the car, care being taken to see that no heavy articles are pressing on them, and that nothing oily is anywhere near them. The repairing of tyres on the road should, if the system I have described be carried out, hardly ever be necessary; but the motorist should be careful to carry a proper car-repairing outfit, and to see from time to time that its contents are in proper condition; otherwise, when he needs it most, he may find that his stock of rubber solution has perished or mysteriously dried up.

But whether on the road or in the motor-house the method of repairing pneumatic tyres is the same. The only repairs which I recommend the motorist to make himself are the patching of the inner tube, the filling up of very small cuts in the outer cover which have not penetrated as far as the canvas or other fabric of the tyre, or in the event of a large gash or burst, the fitting of a temporary sleeve or bandage over the damaged tyre for the purpose of getting the car home. All further damage, such as deep cuts in the outer cover, bursts, blisters, or swellings caused by dirt working through cuts in the tyre to the canvas fabric, or actual wear of the tread itself, is

a matter for the makers of the tyre, who alone can repair it efficiently and economically.

We will take the commonest trouble, which is caused by the piercing of the outer cover and inner tube by a nail or other puncturing agent. Such an accident causes an immediate deflation of the tyre, and it is impossible to run the car on it without doing it serious damage. The first thing to be done is to jack up the wheel from the ground by placing the jack beneath the axle spring and raising it until the wheel is well clear of the ground. If the wing of the car is in a position where it impedes one's movements, it will be found a saving of time in the end to remove it before beginning the repair. The next thing is to locate the puncture from the outside of the tyre if that is possible; if it has been caused by an ordinary nail, the nail should be withdrawn and the hole marked round with a piece of chalk which should be carried with the repair outfit for that purpose. The wing nuts, by which the tyre is attached to the wheel, should then be removed and put in a safe place, and the air-valve unscrewed. The outer cover should then be removed in the way illustrated at the end of this chapter, care being taken to use the special tyre levers provided by the makers of the tyre, and so to use them that the inner tube is never either jammed against the rim or nipped between the point of the lever and the outer cover. One edge of the cover is first prized over the rim, and then, by the insertion of levers at intervals throughout its circumference, the whole of one edge of the cover is brought over the rim. The other edge of the cover is then worked over the rim if it is desired to take off the cover altogether; otherwise the inner tube can easily be removed after one edge has been lifted over the rim.

When the inner tube has been freed the puncture ought to be visible if it was marked on the outside of the tyre; otherwise it will have to be located by inflating the tyre and examining it carefully until the place where the air is escaping is found. When it has been discovered the tyre should be placed flat on a smooth piece of wood and the surface round the puncture rubbed with a piece of emery paper held round some smooth object, such as a lever or spanner. The surface should be rubbed until it is quite rough and clean for some distance round the puncture. The cleaned surface should then be

covered with rubber solution. A piece of patching rubber, the very thin rubber sheeting supplied with the outfit, should then be cut to the size of the solutioned surface, and a patch of thicker rubber should also be cut of a very slightly larger size.

The solution on the tyre will have dried well by this time, so another coating of solution should be applied to it. This in turn should be left to dry for five minutes, and then a third coating of solution should be applied. While this is drying the thin rubber patch should be coated with solution on both sides, and the outer patch coated on one side. When the solution on the tube is in a dry and sticky condition the small patch should be applied to it and the outer patch pressed well down over that by means of the tyre lever or a piece of wood. The repair should then be spread well over with French chalk, so that the tube will not stick to the cover.

To repair the outer cover, if the puncturing nail was a thin one, it will be enough to patch the inside of the cover with a piece of solutioned canvas. In case of a burst or very bad gash the Continental Tyre Company and the Dunlop Company recommend the use of their leather sleeves, which are applied over the whole tyre and rim when the tyre has been put back into place and slightly inflated. The cover is then laced up tight and the tyre fully inflated. This device will be found very useful in cases where a spare cover is not carried. For very bad gashes, where the cover has been cut by a large flint and the inner tube has burst right through it, the Continental Tyre Company have supplied a special plaster which is placed on the inside of the cover under the damaged place. This is provided with ends which overlap the edges of the cover, and it is kept in place, not only by solution, but also by the pressure of the inner tube against it. When the tyre has been replaced and slightly inflated, the Continental "cover plaster," a kind of long band or puttie, is wound round the tyre. This is done by buckling one end of the puttie to a spoke some distance on one side of the puncture and winding it like a surgical bandage round and round the tyre and rim, the other end being buckled to the nearest spoke. In applying this bandage care should be taken so to wind it that each coil overlaps the previous one; and also that the winding begins on the rear side of the puncture (supposing the wheel to be turned so that the puncture is at the

top) and finished on the forward side of it. The action of the road will then tend to smooth down the bandage instead of tearing it up and fraying the edge of each separate coil. The tyre should be pumped up to its full extent after the bandage is put in place.

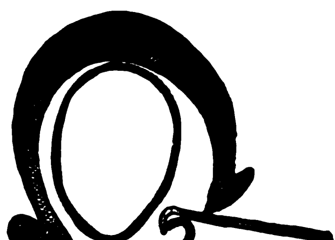
In replacing a tyre after it has been repaired even more care is necessary than in taking it off, otherwise the inner tube is almost sure to get nipped between the rim and the outer cover, when a burst is sure to take place. There is also the danger of nipping or cutting it with the end of the lever.

To replace a tyre the inner tube should be inflated with a few strokes of the pump and then placed in the cover, great care being taken that no dirt, grit, or foreign substance has got into the outer cover. Then put the tyre on the rim, first putting the valve through the hole provided for it. One edge of the cover may then be pressed with the hand into the rim, the studs as they are inserted into their holes being pulled outwards towards the hub. When no more of the tyre can be pressed in with the hand, the levers must be used until the whole of one edge of the tyre is within the rim. It will then be found that the edge of the tyre is seated in the studs instead of between them and the rim ; and this must be put right by levering the edge of the tyre outwards over each stud in turn while the stud is thrust upwards for this purpose. Before proceeding to attach the other side of the cover, the hand should be run round the tyre between the inner tube and the stud to make sure that the tube has not been nipped. The other edge of the tyre may then be put in place by means of the special lever. When the outer cover is in place the studs should be tested ; this is done by pushing them up and down, the wing nuts having previously been screwed on to the ends by a few threads, when if no great resistance is felt to the pushing in of the studs, it may be assumed that the inner tube is properly in place. If there is any obstruction, the outer cover should be lifted slightly at that point with the lever and manipulated until the inner tube is free. The valve and nuts should then be tightened, care being taken to do this by hand only and not with tools, after which the tyre may be fully inflated and the valve and nuts given a final turn to ensure their being tight. The jack may then be removed and the wheel is again ready for the road.

1. DETACHING COVER: THE HAND HELPING THE LEVER TO PUSH THE TYRE OUT OF THE RIM

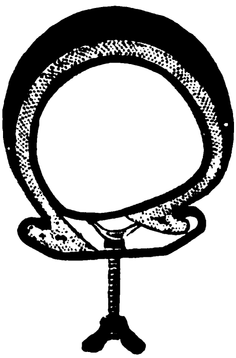
2. THE LEVER RAISING THE COVER OVER THE EDGE OF THE RIM

3. THE HAND HELPING THE LEVER TO PULL THE COVER DOWN, OUTSIDE THE RIM

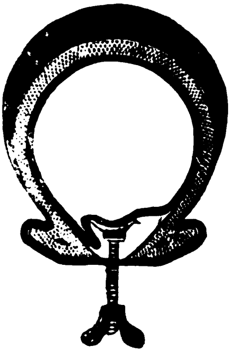


4. RE-FIXING: THE HOOKED END OF THE LEVER LIFTING THE COVER INTO THE RIM

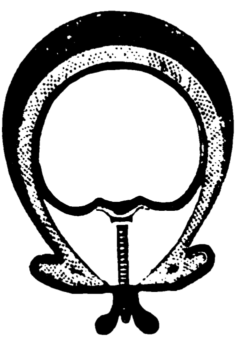
MANIPULATION OF DUNLOP TYRES



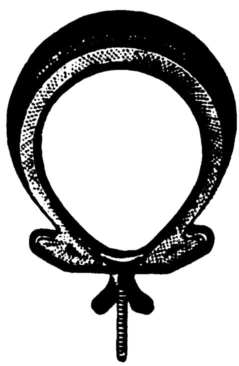
5. A FAULT OF NEGLIGENT ATTACHMENT: A RIM BOLT PREVENTING THE EDGE OF THE COVER SLIPPING INTO PLACE



6. ANOTHER FAULT: AIR-TUBE BECOMING NIPPED UNDER RIM BOLT



7. HOW THE RIM BOLT, BY BEING PUSHED INTO THE TYRE BEFORE BEING SCREWED DOWN, ALLOWS THE COVER AND TUBE TO FIT PROPERLY INTO POSITION



8. THE TYRE CORRECTLY FITTED

MANIPULATION OF DUNLOP TYRES

PUNCTURES AND SIDE-SLIP

The soft, smooth surface of a pneumatic tyre, which renders it so liable to puncture, is also on smooth and greasy pavements a fruitful cause of that most dangerous form of accident on a motor-car, side-slip. The action of the steering and the slope of the road tend to induce a lateral movement in the body of the car, which the smooth tyres of the wheels are powerless to arrest; the result, unless the movement is checked, is that the car swings sideways into the nearest kerbstone, shop window, or omnibus, as the case may be. Various devices have been designed to prevent side-slip and at the same time to protect the tyre from puncture. Nearly all of these take the form of a band vulcanised (or laced) to the tread of the tyre, the surface of the band being in some way roughened to give it a grip of the road. In the Wilkinson band and the See band, both of which are largely used, the necessary roughness is provided by a number of metal studs or fine wires fastened into the band, which bite through mud and grease, and at the same time form an armour round the tyre to protect it from puncture.

A unique device, and one that has proved thoroughly successful as a preventive of side-slip, is the Parsons chain. This consists of two wire hoops encircling the rim of the wheel on each side of the tyre, and joined together across the tread by a series of small, flat curb-chains. These chains are arranged in zigzag, and so bite the surface of the road if the wheel makes the least movement sideways. They are quite loosely fixed, and are free to creep round the wheel as it rolls; thus the wear of the rubbing chains is distributed evenly round the tyre, and is found in practice to damage it but little. Although these chains are unsightly and somewhat expensive, and may in some hands be troublesome to take on and off in the event of any adjustment having to be made to the tyre, they are an absolute protection from side-slip, while their effect on the speed of the tyre is practically *nil.*

Another mechanical device for preventing side-slip consists of an arm which projects downwards from the back of the car to the road surface, carrying at its extremity a small wheel. From its upper end two side arms diverge outwards and down-

wards; and so long as the car is travelling forwards or backwards these arms are kept clear of the road. But if the rear of the car begins to slip sideways, the lateral movement causes the arm on the side towards which the car is tending to slip to engage with the road surface, and to arrest the lateral movement. This device, although it is not widely adopted, has been used with great success. Other non-slipping devices consist of steel plates fastened on each side of the rim of the wheel, armour plates linked together over the surface of the tyre (as in the device known as "l'Empereur," which secured the gold medal in the Automobile Club's trials of non-slipping devices in 1904), and discs engaging with the road surface. Nearly all of these have their peculiar disadvantages, such as cost, weight, and absence of wearing qualities. Perhaps the best plan so far is to have simple bands, such as the See, fitted to the near rear wheel and the off front wheel, if only two bands are to be fitted; otherwise, to have the whole four wheels fitted.

It is a good plan to equip the rear wheels of all touring cars with nail-catchers. These consist of light metal shields so fixed that they just touch the surface of the tyres at their rearmost point, a light spring holding them in contact. Any nail or other puncturing agent picked up by the tyre is thus rubbed off before it has been worked into the fabric by successive revolutions of the wheel. There is naturally no evidence to show how many punctures have been prevented by this device; but very few motorists who have ever used it would willingly be without it.

CHAPTER XII

ACCESSORIES AND LITERATURE

The delusion of the accessory—A buttress to enthusiasm—Concerning lamps—The right and the wrong kind—Horns and their uses—Beware of the speed recorder—The time superstition—A better way—Clothing for motorists—Odds and ends—The *Autocar* and the motor movement—The *Automotor Journal*—The *Motor Car Journal*—The *Car* and its editor—A triumph of personality—*Motoring Illustrated*—The *Motor* and men of moderate means—The *Motor News* and the *Motor Car World*—The *Club Journal.*

IT is one of the snares and pleasures of motoring as a recreation that the purchase of the motor-car itself is only a preliminary, and is far from representing the motorist's complete equipment. The accessory and the important part it plays in any pastime have yet to be done justice to; at present we all seem to combine in pretending that the accessory is merely an accessory, and nothing more. But people who have been possessed by the various rages and fads that succeed one another in popular entertainment know in their hearts how serious and how fateful a thing the accessory may be. It comes humbly in the guise of a mere detail, a useful and innocent supplement to the principal affair; it ends as often as not triumphant and essential, diverting to its own use the funds, the time, and the affections that had been destined for more important ends.

I remember in my bicycling experience the whole evolution of my interests; how I began by being pleased enough with a naked bicycle and with exhausting myself in its proper and legitimate function. Then came the days when I took an overwhelming interest, not so much in riding the bicycle, as in decking and loading it with a full equipment of all the unnecessary things that the mind of the accessory dealer could

devise. Rim brakes, patent saddles, oil-cans (how many oil-cans have I not owned!), bells, cyclometers, and so forth—my interest was diverted to these, my pocket-money also. Then came a day when, having grown quite tired of bicycling as an amusement, I could not bring myself to mount the machine unless I had some new accessory to act as a whet to my jaded appetite for cycling. At first a brightly-plated spanner, a patent oil-can, an "adjustable" lamp bracket, would suffice, and the knowledge that I carried them on the machine would buoy me up throughout a morning's pedalling. But afterwards more elaborate excitants became necessary, and patent fork-expanders and "speedometers" were pressed into the service. The original cost of a new machine had by this time been far exceeded by that of the confusion of accessories that now disguised my old one; and daily the price which I must pay for the desire to mount my bicycle grew higher and higher, until the climax was reached when I rode about after dusk with a small dynamo geared to my front wheel beaming an electric path in front of me.

The latter days of the bicycle furnished a moral. I gave it to the youth who looked after my motor-car, and he stripped it naked to the rims, cleared it of the mud-guards, patent brakes, clips, stays, springs, and fixings with which I had loaded it, and —rode it; and it may still be seen about the roads and lanes of Epsom, leading in its old age the honourable and useful existence of a bicycle.

The moral of this tale is that the occupation which is merely a hobby will ultimately be devoured and destroyed by its parasite accessories. I had no real use for a bicycle, and so I tired of it; and I have observed the same state of affairs to exist among people who dally with photography, but who do not work at it. The photographic parasite is even more deadly, numerous, and expensive than that of the bicycle. The photographic hobby begins with cameras, plates, and photographs; it ends in a ruinous litter of patent cameras, feather-weight stands, lightning shutters, films, chemicals, lamps, dishes, printing frames, stirring rods, mount cutters, hundreds of mounts and printing papers, albums and negative cases—but no photographs. What it would be in the case of motoring if that were merely a hobby and amusement I shudder to think. Fortunately,

it is rational and useful; and fortunately, also, it is expensive enough not to be enterprised nor taken in hand lightly, unadvisedly, nor wantonly.

The things that are absolutely essential adjuncts to the motor-car itself ought to afford quite a large enough field for the activities of the most extravagant. There are lamps, for example. You may very easily spend £30 on a set of lamps with the assurance that if you are tired of them in six months it will be quite easy to spend another £30 on more lamps of a newer pattern. But this is quite unnecessary. The blinding search-lights used on some cars are both disagreeable and dangerous, and render everything outside their field absolutely invisible. For ordinary starlight or moonlight nights two good paraffin lamps are all that is necessary for a car that travels at less than thirty miles an hour. On dark nights it is advisable, when driving in the country, to carry on such cars a single headlight of greater power; and there are several good carbide lamps on the market costing from £2 to £10 that will fulfil this purpose. Carbide lamps give a beautiful light when they are working properly, but they need a great deal of attention, and are very dirty and noisome to work with. I advise the motorist in any case only to use carbide lamps which are entirely self-contained and which do not need separate generators. The tubing in connection with these is almost sure to give trouble, and the lamps which may go for months at a time unlit are almost certain to be exhausted when they are needed most. A kind of lamp also to be avoided is that in which there is no tap for turning off the gas, so that the user has to guess by the amount of water which he puts in how long the lamp will burn, with the result that it either goes out before, or continues to burn long after, he has finished with it. On very fast cars two of these headlights should be carried and always used after dark; but as the driving of fast cars on dark nights is a very dangerous thing to do, so much light should seldom be necessary. The best tail-light is a simple paraffin lamp with a fairly large and loose wick; but as there is much jolting at the rear end of the car, tail-lamps should have such springs that it is impossible for them to jolt out, the result of which may be a heavy fine.

I am surprised that more attention has not been paid to the

lighting of motor-car lamps by electricity, which is so very clean and simple a method. Upon any car of over 10 h.p. which is used much at night it would be well worth while to fit a small dynamo and accumulator, the dynamo being arranged so as to be easily thrown out of gear during the day. The first cost of this would not be greater than a full set of oil and carbide lamps, and its cost of maintenance would be much less, while the power absorbed would be unimportant. On very small and cheap cars where simplicity is the first consideration, such an arrangement would be unsuitable, but on large cars it would be a practical economy and would be really simpler than all the troublesome paraphernalia of carbide lamps.

Even in such things as horns the motorist has an immense range of choice, and an immense power of making himself disagreeable if he so chooses. The note of the motor-horn is not beautiful; it is, indeed, hideous; but it seems so far to be the best and safest device for attracting the attention of the other users of the road. It is better than a shrill railway whistle, and a bell which would be loud enough to serve the same purpose would be even more disagreeable. The gongs used on some small and silent cars are very musical and pleasant to listen to, but unfortunately they do not always attract the foot-passenger's attention quickly enough; and upon that trial of the motorist's patience, the deaf and leisurely old gentleman, their silvery chime is entirely without effect. With regard to horns, it is better to have a large horn than a small one; its deep and gruff note is less offensive than the squeak of the little horn, and it can be sounded quite gently if necessary. For cars, however, which travel at a higher speed than forty miles an hour the ordinary horn with a bulb adjustment is insufficient, as the rush of wind into the mouth of the horn prevents the short intermittent sound from carrying. For this purpose a prolonged blast of not too low a pitch is necessary for the public safety—that is to say, if you are the sort of person who travels at more than forty miles where people are likely to be in the way. If you are, my only advice is that you should have a connection from the exhaust pipe led into a small reservoir and thence into the horn, so that on turning a tap a prolonged hoot will be emitted. And I hope you will be heard and seen of the police.

There is no end to the number of fittings which the enthusiast may have upon his dashboard—most of them very costly and of doubtful utility. But a good carriage clock is a necessity, while a gradometer, for measuring the gradients over which the car is travelling, is a rather interesting accessory to a touring car. There are "speedometers" now made which I believe are very accurate and trustworthy in recording in miles per hour the rate at which the car is travelling; but I doubt whether they give much pleasure to the average owner of a car. Without their cold correction he probably estimates his top speed at at least five miles an hour more than the actual rate of travel; and if it pleases him to do so it does no one any harm. But with the machine on his dashboard he is forced to accept the correction of facts, or else doubt the accuracy of the instrument; and it is poor comfort to depreciate a thing for which you have paid £10 or £15. Indeed such is the invincible belief of the average motorist in the speed of his car that I cannot imagine that these instruments are regarded by their owners with much favour—unless some genius has devised one that always adds ten per cent. to the actual speed attained. I have so often sat beside the owners of cars and at their request timed them over several miles that I have no little experience in the psychology of this time-superstition. It is a strange fact that when I have been thus testing the speed of any car it has never been doing its best; and cars that did fifty miles an hour only the day before, have never been able to approach forty-five when I have been on them. As mile after mile has been recorded under every favourable condition of road at a speed humiliatingly at variance with the boasted achievements of yesterday, and as the driver's excuses and explanations have become more and more feeble, I have often, out of sheer embarrassment, deducted some seconds from the actual time with a view to putting the discomfited driver out of his misery. But the optimism of most men in such circumstances is invincible; and when every other excuse has failed, I have been solemnly assured that "the milestones must be wrong." The only exception to this rule seems to be in the case of police prosecution; and even then the powers of slowness attributed by some motorists to their cars are on the same finely imaginative scale. On the whole I do not advise the ordinary motorist

to have a speed recorder. An old watch that loses a few seconds in every minute will give far more satisfactory results, and provide, at a trifling cost, a deal of innocent pleasure.

The kind of clothes one wears when motoring is important. It is evidently thought by some motorists (with a propriety of which they are quite unconscious) that it is necessary to dress themselves in hideous garments; hence the black leather coat, the black leather breeches, the black leather cap. As a matter of fact it is possible for the motorist to wear clothes of ordinary cut and appearance; but for travelling in any but the warmest weather it is absolutely necessary that they should be lined with some substance which is impervious to wind, such as chamois leather. The use of mackintoshes or capes that might blow up against the face should be avoided by the drivers of motor-cars; and for wet weather there is nothing like the ordinary *parapluie*, with a rubber neck and wristbands. Leather leggings make the best protection for the lower limbs, as the use of a rug is practically impossible, or at any rate rather unsafe for the man who is driving, as the rug may get jammed below one of the pedals at an awkward moment. It is quite possible, however, to arrange a leather apron that can be hooked to the dashboard clear of the pedals and fastened to the seat. In wet weather this is an excellent protection. Goggles are, unhappily, almost a necessity when travelling at any but the lowest speeds; and, unlovely as they are to look upon, it is better to be able to keep one's eyes open and see what is going on, even at the cost of temporary disfigurement, than to screw them up and see nothing. The clouds of gnats and flies that hang in summer just at the elevation at which one's head passes when one is driving in a motor-car are both unpleasant and dangerous—unpleasant if they get into your mouth and dangerous if they get into your eyes. For ordinary wear the goggles made of thin convex glass surrounded by an edging of thin silk are quite sufficient; but for very fast travelling the heavier glasses in a ventilated metal framework and with a light leather mask attached are safer and better.

On the sacred subject of dress for women, even when they are motoring, I do not venture to speak; my impression is that long before even the kind of motor-car to be bought has been decided upon a woman will have purchased a complete outfit of

coats, hats, and veils. From what I see in the motoring papers which devote themselves to such matters, I do not think that much advice or assistance is needed.

It is in the very small accessories, however, the mere quality of which would to some people appear to be unimportant, that the difference between the well and badly equipped motor-car is seen. Just as in the case of a well-found yacht, where the quality and condition of anchors, cables, decks, seams, brass-work, lockers, and fenders reveal the careful or careless owner, so in a motor-car attention to details is generally the best evidence of care and attention to more important points. The arrangement of lockers inside the tonneau of the car, for instance, may have much to do with the comfort or discomfort of the passengers. If bundles of oily waste and the inevitable half-tin of lubricating oil are found invading the space which should be altogether at the disposal of passengers, inconvenience and dirt are sure to result. There is nothing in which the petty virtue of orderliness is so necessary, or where the absence of it is so disastrous, as in a motor-car; and proper and exclusive accommodation should be provided for such things as tools, tyre materials, oil, and spare parts of every description, without encroaching on the lockers and pockets that ought to be reserved for the personal belongings of the passengers.

The disposal of all these matters and the provision of suitable accessories make a very pleasant part of the motorist's occupations. Even such a thing as a jack (which ought always to be carried) affords scope for ingenuity or the reverse. Jacks should be as light, as strong, and as small as possible. All that they are wanted for is to lift the car a few inches from the ground, and they should be of the kind that acts through a screwing motion and not by means of pressure on a lever. Some people carry them underneath the body of the car and just at the rear, but they are almost sure to get dirty and rusty here, and may not improbably be dropped off or forgotten. It is better to keep them in a cupboard inside the car. The tyre pump should be carried in a conspicuous place—for instance, in the clips on the inside panelling of the car; it should be of ample size, and have a pressure gauge attached showing the pressure of air pumped into the tyre. But the back-breaking work of pumping pneumatic tyres is a thing which no wise man

will do if he can get it done for him mechanically. On steam cars having an auxiliary air pump it is easy to fit a connection for blowing up the tyres, but the petrol car was for long without any such device. This want is now filled, however, by a small fitting called the "Pompeesi," which is attached to the frame of the car near the engine. A coiled copper pipe is led to it from the cylinder, and when the engine is running the small cylinder of the "Pompeesi" is thus filled with exhaust gases under pressure. By a series of circulating plates inside the cylinder a centrifugal movement is imparted to the gases by means of which they are freed from any foreign matter; and a rubber tube connected to the cylinder delivers the pressure to the tyre. The carbonic acid in the exhaust gases has no bad effect on the tyres, and is even said to be beneficial to them. This is one of the many simple ways in which the waste power contained in the exhaust gases of the petrol motor can be used with great advantage.

Membership of the Automobile Club is perhaps not so much a duty of motorists as it was in the early days, for the club is now strong and independent. But if it is no longer a duty it is still a privilege and an advantage. The officials of the club are always more than ready to give every advice and assistance to motorists; and for those who take their motor-cars abroad membership of the Automobile Club is almost a necessity, simplifying as it does the otherwise elaborate and costly formalities which are imposed on the other side of the Channel. The various trials arranged by the club are also of great practical value, as well as being of interest to the amateur; there is indeed always something going on in connection with the club to provide the enthusiast with amusement, occupation, or instruction.

And last, but not least, there are the weekly automobile papers, some of which it is advisable, in the changing conditions of the industry, that every motorist should read. The chief of these is the *Autocar*, which was established in the year 1895 by Mr. Henry Sturmey, at a time when it was not lawful to drive motor-cars on the road at a pace exceeding four miles an hour, and when it was necessary that a man with a red flag should walk in front. The paper, modest as its proportions were in those early days, was severely ridiculed; and, as the foremost

question then was how to get the law altered, the *Autocar* devoted itself to arousing an interest in automobilism among the general public. The paper, which was made as interesting as possible, was sent to all members of Parliament, to the whole of the Peerage, to country houses, and to large manufacturers and professional men. By this very expensive but useful policy there is no doubt that public opinion was both interested and educated. When the Light Locomotives Bill was brought in by the Government, the *Autocar*, in order to do everything possible to assist its passage, organised a great petition praying for the necessary alteration of the law, and this petition was signed by over eight thousand persons.

Since those days the *Autocar* has been considerably developed until it has obtained its present high position in the Press of the country. It is not too much to say that its position in the world of automobilism corresponds to that of the *Engineer* in the world of general mechanical engineering. It does not aim at being a popular paper; its interests are entirely educative, technical, and serious; and its great popularity is the more remarkable on that account. Its advertising pages would form by themselves a pretty fair record of the automobile industry; and its sound policy and sober judgment on all matters connected with the technical side of motoring cannot be too highly praised. It is always ready to ventilate and encourage new ideas, yet at the same time it takes sober views, and forms about as admirable a contrast as one could imagine to the American automobile papers of similar pretensions. Its correspondence columns are well conducted, and attract in the course of a year all the thought and opinion that is really valuable in the technicalities of motoring. Like most of the other automobile papers, it is admirably printed and illustrated, and the drawings which it gives of new inventions are always authoritative and valuable. In a word, it is the supreme authority in the Press on all matters relating to the design and construction of motor-cars, and its approval, which seems to be founded solely on judgment and experience, and never to be influenced by extraneous circumstances, has more value than many medals and diplomas. The *Autocar*, the price of which is threepence, is published every Friday by Messrs. Iliffe & Sons, Limited.

Of quite a different character, although of hardly less

authority and reputation, is the *Automotor Journal*, which was established in 1896 before the new Act came into force. The *Automotor Journal* is probably the best written of all the automotor papers, and while it takes a considerable interest in the industrial side of the movement, concerns itself chiefly with the interests of private owners of motor-cars. If I were asked to say off-hand what I consider the two most important features of the *Automotor Journal*, I would choose the editorial articles and the illustrated descriptions of motor-cars which appear weekly. The independence of tone, as well as the common sense and moderation of the leading articles in this paper, are of the greatest importance in the present youthful days of the motor movement, and must often exercise a most beneficial and restraining influence on those members of the motoring public whose behaviour is more like that of vulgar excited children than anything else. As for the articles descriptive of various cars and systems, I know no piece of serial journalism that is better done, or in which so high a standard has been maintained over so long a period. If these articles, since the first appearance of the paper, were taken out and republished, they would form a most valuable technical work of reference on motor-cars. They are written by an expert, with the motor-car before him, and often the car is dismembered and its machinery photographed piece by piece, the method of construction, as well as the action of the machinery, being minutely described. The excellence of the illustrations, which, being nearly all taken from photographs, are more intelligible than technical drawings to the amateur, combined with the clear and full information given in the letterpress, makes these articles in themselves a complete education in the principles of motor-car construction. Very full accounts are given in this paper of the doings of the Automobile clubs, and any lectures of interest that are given on automobile subjects are fully reported and illustrated; in fact, the *Automotor Journal* combines very happily a study of the interests of the expert and the amateur pure and simple. The price of this paper is threepence weekly, and it is published by Messrs. F. King & Co., Limited.

The *Motor Car Journal*, which is descended in a direct line (through *Iron* and *Industries and Iron*) from the *Mechanic's Magazine* of 1817, is in its sixth year of publication in its

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present form. It is the property of Messrs. Cordingley and Co., and has from the first devoted itself to popularising the motor movement, and has paid much attention to the encouragement and record of progress in heavy motor traction; but it also gives very full and sufficient attention to all matters connected with light motor-cars. It is not so elaborately printed or illustrated as some of the other papers; but it nevertheless gives the purchaser more for his money than any other motor-car paper, with the possible exception of the *Motor*. As it contains twenty-five pages of letterpress and illustrations and thirty-eight of advertisements, and costs only one penny weekly, it cannot be called an expensive paper. It must be remembered with regard to all illustrated automobile papers that the advertisements are not the burden to the general reader that they are apt to be in ordinary publications, because advertisement pages, admirably illustrated, are often just as interesting and instructive as the rest of the paper.

The *Car*, a comparatively late comer into the field of motor-car journalism, is also quite unlike any of the other papers. It is, in fact, a weekly illustrated paper something on the lines that were laid down long ago by the *Graphic* and the *Illustrated London News*, but have been so fully developed and so much adapted for other purposes. The *Car*, however, concerns itself almost exclusively with automobile matters, and with these chiefly on the social side. Its somewhat curious sub-title—"A Journal of Travel by Land, Sea, and Air"—was doubtless decided with an eye to the future. Already the "sea" department has become justified in the remarkable development of the pastime of motor-launch racing; and, no doubt, also the third department, which concerns itself with the upper air, will soon be crowded with news of the doings of air-ships. In the meantime, however, the *Car* has achieved a very remarkable success, and this, I think, almost entirely owing to the personality of its editor, Mr. John Scott-Montagu, M.P. I spent a long evening reading through a bound volume of the *Car*, and I was, I confess, puzzled for a time to know how to account for its success. It is not particularly skilfully written; the generous type and numerous large photographs somewhat restrict the actual amount of matter which it contains. It is, indeed, superbly illustrated; but then so are dozens of papers which

cannot hope for half the *Car's* success. But on studying it for a little while, it becomes clear that the characteristic feature of the *Car* is that from cover to cover it is the expression of a personality, and that one of the most interesting personalities in the automobile world. It exhibits a kind of boyish enthusiasm for all the externals of motoring, combined with a very shrewd, a very courageous, and a very able conduct of what may be called the public policy of motoring. Not only that, but in the political and social world the editor of the *Car* is an untiring champion of all the rights of motorists, and he is as formidable when he sets the wheels of the social and political machine to work in their favour as he is engaging when he airs his opinions upon every matter that comes within his purview. If one may be permitted a somewhat clumsy paradox, one may say that the *Car* would not be half so good if it were better done—better, that is to say, from the point of view of the professional journalist. But no professional journalist could either have evolved the *Car*, nor could he have kept it going for six months. Its success is due chiefly to the quality I have mentioned, partly to a certain amount of really first-rate information with regard to roads and railways, partly, no doubt, because of its many photographs of pretty and notable women in pretty and notable clothes, and partly because of that atmosphere of amateur enthusiasm which no professional journalist, however skilful he may be, can ever maintain as it is maintained in the *Car*. The price of the *Car* is sixpence weekly, and it is published by Messrs. Eyre & Spottiswoode.

An offshoot of the *Car* is the *Car Magazine*, which is also edited by Mr. John Scott-Montagu. This is a monthly magazine, the chief features of which are its beautiful illustrations, its interesting articles of travel, and the inexhaustible personality to which I have just referred. The first number was published in August, 1903, since when this magazine has gained steadily in popularity, not only with motorists, but with all those who are interested in progress and travel, and like what they read to be luxuriously printed and handsomely illustrated. The price of the *Car Magazine* is one shilling monthly.

Motoring Illustrated, which is owned and edited by the Messrs. Kenealy, was started on March 8th, 1902, as a weekly illustrated paper devoted chiefly to the sporting and social side

of motoring. Its price was then threepence, but on February 20th, 1904, this was reduced to one penny weekly, which made it, I believe, the only penny paper in the world printed on art paper. Its characteristics are its first-rate illustrations of late motoring news, and a certain "smart" tone such as is associated with the new daily journalism. The fact that its letterpress consists almost entirely of paragraphs, occasionally of a flippant character, may detract from its interest in the eyes of a certain class of reader; and I think that nothing but improvement would result if it left its readers to discover its many good qualities for themselves, and did not continually call attention to them with a somewhat monotonous insistence. But there can be no question as to the journalistic ability shown by it in giving real news, as distinct from general articles, at the earliest possible moment. On the occasion of the Gordon-Bennett Race in Ireland *Motoring Illustrated* transferred its offices to Dublin, and on the morning after the race—that is to say, less than twelve hours after the finish—issued a special edition, splendidly illustrated, containing a full report of the event. This was really a brilliant feat of publishing, and fully deserved the high praise which it won from every quarter. This lead has been well maintained, and *Motoring Illustrated* is nearly always first in the field with fully illustrated news of any important event.

The *Motor*, which started as *Motor Cycling* and rapidly attained to a very large circulation among motor cyclists, soon found that the interests of its readers demanded that more attention should be paid to the interests of motorists of moderate means, and therefore changed its title and devoted itself to the development of the light car as well as of the motor-cycle. The great ability with which this paper is conducted, the really helpful information which it gives, and the enormous correspondence which it attracts by virtue of its large circulation, give it, in my opinion, a unique value and position in the automobile Press of the country. It represents, so to speak, the nursery of automobilism; it devotes itself to the help and encouragement of the beginner; and many a one who has begun with a motor cycle, passed on to a light car, and thence to the full joys and difficulties of the touring car, has reason to be grateful to the *Motor* for not a little help and sound

guidance. It is full of good pictures; its advice comes hot and hot from the experiences of its staff; and the weekly articles of "Cyclomot," for example, hardly ever fail to contain something that it is both interesting to read and useful to know. Not the least of this paper's good qualities is that it concerns itself with the interests of men to whom shillings matter, and its policy is consistently one of developing and encouraging cheap motoring. It contains seven or eight pages of correspondence every week, any novel point in which is illustrated; and in addition hundreds of replies are sent through the post. I am sure that there is a great future before this paper, and that it will be flourishing long after motoring has ceased to be merely the rich man's craze. It is published by the Temple Press, Limited. Other motoring papers are the *Motor News*, published and edited by Mr. R. J. Mecredy, an admirable periodical full of sound information for the private owner of a motor-car; and the *Motor Car World*, published by Messrs. Hay, Nisbet & Co., Glasgow.

The *Automobile Club Journal*, which is published weekly and distributed free among the members, has received a good deal of criticism because of its alleged competition with the public automobile Press. Conducted on purely commercial lines, there does not seem to be very much need for it, unless it is admittedly the best, the most representative, and the most authoritative of all the automobile papers—which it is not. But as a purely official organ, giving club news in full, announcing the results of public trials and competitions, and voicing the official opinion of the Club on all automobile matters, I think that it has a very genuine reason for existence. In this case, however, I think its weight and authority would be vastly increased if it did not accept advertisements; in fact, there seems to be a certain impropriety in the receiving of money by the Club from motor traders in return for advertisement. The Club is surely rich enough to be independent of this doubtful source of revenue.

CHAPTER XIII

A PACKET OF LETTERS

Letter from Lady Jeune—The social side of motoring—Fresh air and the bicycle—An escape from the chaperon—A disadvantage of easy locomotion—The importance of solitude—The difficulty of finding it—The monster in the stables—A selfish enjoyment—A vision of the future—The autocrat of the stable.—Letter from Sir Horace Plunkett—A substitute for hunting—Early experiences—In Ireland—Local talent—The motor as time saver—Problems of the road—With the King in Ireland.—Letter from Mr. Strachey—England's back premises—Practical uses of the motor-car—Back to the country—An improvement in roads necessary.——Letter from Mr. Jarrott—The charm of racing—Its departed glories—Sport rather than speed—A cure for monotony.—Letter from Major Lindsay Lloyd—The military motor-car in peace and war—Its use in manœuvres—Where it is essential—Is it useful in war?—A combination with animal transport—A golden rule.—Letter from Mr. Rudyard Kipling—His early agonies, shames, and delays—Chasing the inchoate idea—The chance-met dung-cart—His mouth emptied of vanities—His emancipation from Jack and Jenny—The discovery of England—The time machine—The motor-car as temperance advocate—A condition, not a theory—Effect upon carriers and coachmen—A rooster and his judgment—Incident of the dog.

THE writers of these letters need no introduction from me. Each of them is identified in the public mind with a particular department of life, and each has place in the public esteem by virtue of a peculiar fitness for it; nevertheless, I venture to think that my six correspondents embrace in their persons and qualities a fairly wide range of human interests and human equipment. Mr. Strachey and Mr. Jarrott, Sir Horace Plunkett and Major Lindsay Lloyd, Mr. Kipling and everybody else—if one had been making a study in contrast, a more piquant choice could hardly have been found; while Lady Jeune's position in the life of our day is both unique and representative. Yet their association here is purely by chance; and from regions of human activity so divergent they have been brought into a momentary companionship on this page by

virtue of no stronger bond than the fact that two accidental circumstances are common to them all. The one is their belief in the motor-car as a great and increasing influence in the national life; the other is their acquaintance with their common correspondent. Perhaps I may be allowed to add a third element in the bond—the good-nature that prompted them so kindly to pay the toll levied on their friendship, and to spend time and trouble for the embellishment of someone else's work.

I

FROM LADY JEUNE

79, HARLEY STREET, W.,
20th June, 1904

DEAR MR. FILSON YOUNG,

The social side of motoring is a difficult subject, for I find nowadays that as soon as any sport, occupation, or interest gets a social side half its good and all its pleasure is gone. Cycling had its social side, so had boating among other amusements; but the moment they came into universal use they lost their charm. People became frightened of the crowds which took possession of the roads and of the Thames and left both; and the social side of cycling has ceased to interest the community any longer. I am not for a moment going to minimise the pleasure and health both have given to those who still pursue them, for they are both incalculable; but do you think they are any longer the important and all-absorbing occupations of the community that they used to be? The moment any form of exercise is adopted by everyone and becomes the pastime of a huge crowd it loses its charm for its devotees, and they go further afield for a successor. Both cycling and boating possessed a qualification, advantageous or the reverse, in that they were not expensive amusements, and by the help of both the river Thames was rendered accessible to the teachers and the workers, both male and female, of this great toiling metropolis; and what was only for a brief period the pastime of the rich became to them the means of giving them many happy hours during the week of fresh air and peace.

The country owes a debt of gratitude to the bicycle for all

it has done for the classes who labour in large towns; and while the fashionable world has forsaken its first love the sport is pursued with increased devotion on the part of its more humble followers. There was a social side, I suppose, to bicycling: it enabled young people to go out in large parties, unencumbered by the inevitable chaperon, and it fostered, while it lasted, the growing spirit of independence among girls; it enabled one to see more of country neighbours, often a doubtful advantage, and it undoubtedly increased the facilities of locomotion, which, we are told, is the great and inestimable blessing of modern life, an article of faith about which I claim to be unorthodox. Now we hear much of the social side of motoring, and we are told one of its great advantages is that it will give us still greater opportunities of seeing people in the vicinity in which we live, and that it will foster and strengthen that neighbourly feeling which is so delightful, and will add so much to our enjoyment of the country by the ease with which we shall get about. It will undoubtedly enable us to go long distances and penetrate to places otherwise inaccessible; and no doubt we shall be brought into warm contact with many people hitherto strangers. It sounds very nice, very kind, and an ideal picture of what our country life should be. I think, however, that the great charm of the country is being destroyed by that very increased facility of getting about. The great and inexpressible charm of the country is always its peace, more often its solitude, and we are destroying both. There are no longer days when one can sit in the garden dreaming, sleeping, what you will, listening to the whisper of the wind in the trees, the droning of bees, the song of the birds, and the mysterious language of Nature. Such days are a waste of time. There is a monster in the stable who has to be exercised, and from time to time you hear his brothers hooting to him as they rush past along the road, while the irresistible feeling grows on you that you must obey their cry, and start on your ride answering with Valkyrie-like cry the invitation which has been wafted on the sweet summer air. Then, indeed, the fascination of motoring begins to exercise itself, and the enjoyment, which is a purely selfish one, the consciousness that you are getting away from your fellow-creatures, that every man, woman, child, village, hamlet, or town is a landmark passed on the journey which you

would like to lead to perfect solitude—a solitude in which none of the modern necessities of life and society exist—become overpowering. There is no sensation so enjoyable—except that of riding a good horse in a fast run—as driving in a fast motor. The endless variety of scenery; the keen whistle of the wind in one's face; the perpetual changing sunshine and shadow, create an indescribable feeling of exhilaration and excitement; while the almost human consciousness of the machine; the patient, ready response which it makes to any call on its powers; the snort with which it breasts the hill, and the soft sob which dies away when it has reached the summit, make it as companionable as any living being. Then I want all this to bear me away from the haunts of men; but you want me to tell you of another aspect of motoring, and I feel very inadequate to dilate on any of its other advantages. I am willing to admit all the possibilities for good which getting to know your neighbour better entails—and the pleasure which is gained by being able to visit almost every spot worth seeing in one's own country is undeniable; and the convenience of being able to go straight from one place to another without "breaking bulk," as was formerly the case when a journey had to be partly done by road, and rail, is enormous.

But I don't think the social effect of motoring has yet become important. Cars are too expensive, too much of a luxury for any but the rich, to have affected us socially to any great extent. When cars can be made that will cost you £100, or even less, then we may talk of the social effect of motoring on modern life, and the effect will not, I think, be a pleasing one. The country will be invaded by vast numbers of small cheap cars through which the larger and more powerful ones will thunder with more or less disastrous results, for no time limit will then exist, because the roads will not be in possession of the South African millionaire, the rich stockbroker, or the rich autocrat, but Demos will have taken the road, at his own pace, and for his own pleasure, and no County Council will dare stay his headlong progress. Then we shall mourn for the autocrat who presided over the stables, we shall sigh for the smooth, glossy skin, the tender eye, the soft neigh that greeted us in the days when we fed our monsters with carrots and sugar. The announcement that the motor could not go out would

the pasture-lands of Leinster. The motor-car makes me feel again the joy of rapid motion through the air. It gives a cool, exhilarating breeze on a dull stuffy day. On a windy day it can convert an adverse wind to the force of a gale, or can run along with a gale in a perfect calm. And there are other sensations which when I parted with the pleasure-horse I never expected to enjoy again. Of course, the relations between a man and a machine can never be an adequate substitute for the relations between the lord of creation and the animal which, in County Meath, at any rate, is well-nigh his peer. Still a poor driver with a new motor may have quite as lively a time of it as a bad rider on a young colt which is neither bridlewise nor under restraint in its paces. There is to me a keen pleasure in the perfect control I have gained over my 10 h.p. Panhard, whose humours and tantrums frightened me not a little at first and made me speculate irreverently upon its sex. Even now it has its moods, and I have to look after its health to be sure that it will glide along with a contented hum, raising its note slightly and appreciatively when it is given its head on its highest speed.

But to begin at the beginning of my brief narrative. When I decided that my way of life required mechanical expedition I went round the dealers in motor-cars. I could not help wondering whether they had better chances of heaven than the dealers in horses, who take their reward below. My requirements were modest. I wanted a machine which was warranted fool-proof. The dealer who secured my business could meet this requirement, but the warranty must be interpreted with the important qualification that "there are fools and fools." I was too proud to object to this limitation of my terms, and have not on the whole regretted my acquiescence, though there were times when I thought my pocket would have been the richer for my pride. I bought a little 4½ h.p. De Dion voiturette. I recall a curious circumstance which illustrates the way in which the spirit of the horse haunted me up to the very hour of my final desertion. The dealer, a well-known Dublin coachbuilder, who takes pride in the appearance of his work, insisted that my crest and motto should adorn his panels. Parliament had not then made us disfigure our cars with letters and numbers, like an omnibus with advertisements. The motto of our family, *Festina Lente* (which does

It was early in the summer of last year—I forget the exact date, but I can almost fix it by saying that it was a fine day. I ran straight through to Holyhead, in time to put my car on a freight steamer and to get to sleep on the night mail-boat before the passengers arrived. The distance is 257 miles, and I had three tyre punctures on the road.

This journey from London to Holyhead provoked some thought. My father, who died in 1889, and could easily remember the rejoicings when the news of the Battle of Waterloo reached London, used as a boy to travel that road to and from his school in Kent. I once asked him towards the end of his life whether, if I lived as long as he had lived, he thought I should see as great changes as he had seen in his day. He said he thought not, as when he was a boy he could not travel any faster from London to Holyhead than Julius Cæsar. He knew what the iron horse could do on its iron path, but he would have marvelled at this performance of the fool-proof machine over the Holyhead Road. To the makers of the machine which stood such a test belongs the credit, but let the Irish dealer have me in kindly remembrance when he is discriminating between fools and fools.

It is, of course, in short journeys and not in long that the motor finds its business justification for its extravagant existence. As a time-saver and convenience for journeys of thirty miles or less it has enormous advantages over the train, which dictates and does not always observe the appointed hour; which does not come to you, but makes you go to it; which makes you spend at its starting or stopping place whatever margin of time your temperament requires; and which deposits you at its and not your destination. But the advantages of a motor are secured at too great a cost to the man of fortune who can avail himself of them, and at far too great a sacrifice of the general public who use the road in the ordinary way. The dust problem, which I find can be simply dealt with so far as the occupants of the car are concerned, remains to be solved in the interests of the community at large. Their forbearance is remarkable, the public seemingly taking the broad and liberal view—which, I think, is also the wise one—that it is best not to check the progress of a means of locomotion which will soon develop into a great public convenience and utility, by

things about my car. By the way, as you remember, it had the honour of piloting their Majesties over the roads of Connemara, Kerry, and West Cork last year. The motor-car enabled them to meet large numbers of the most typical of the Irish peasants under ideal conditions. I doubt whether any English sovereign was ever brought into relations so mutually agreeable as those which the King enjoyed with the simplest and kindliest of his subjects on this historic tour. I was much struck as I went along with the thoughtful way in which the people removed from the road on which the royal party travelled certain domestic animals whose immemorial privilege in its use no less distinguished guests would be permitted to infringe.

I am,

Yours sincerely,

HORACE PLUNKETT

III

FROM J. ST. LOE STRACHEY,

(Editor of the "Spectator.")

22, SOUTH STREET, W.,

April 12th, 1904

DEAR MR. FILSON YOUNG,

You ask me to tell you why I like motoring, and what I think of its future. I like it in the first place because it makes me free of the roads of England, and enables me to see a vast amount of country which without my motor-car would be a sealed book to me. The railway does not show us the true rural scenery of England because it takes us down, not the historic highways of England lined with the traces of England's past life, but as it were through the "back premises" of the nation's home. England has grown up to face the road, and the railway line always runs away from the "front" view of life. Therefore even apart from the fact that the railway carriage is a closed vehicle, we never get a true idea of what England is like by looking out of the railway-carriage window. This difficulty of seeing a country from the train is not nearly so great in wild and savage countries. There one may get a very good impression by looking through the railway-carriage window. In old historic countries like England one gets to know nothing of the country if one only travels by rail. This,

IV

FROM CHARLES JARROTT,
(Winner of the Circuit des Ardennes Race, 1902.)

April, 1904

MY DEAR FILSON YOUNG,

Why will you ask one questions which necessitate quiet consideration and the searching of the heart to answer? Why do I like automobile racing? I wonder.

Perhaps the real reason is because I like any form of contest. Fairly equal chances and a good fighting finish, and I am as enthusiastic over one form of sport as another. A Bordeaux-Paris bicycle race, a Marathon foot-race, a set-to at the National Sporting Club, or an even tussle in a wrestling match, and I will get up very early and travel very far to see the finish, even as at one time I would have done the same to be a participant.

The automobile sport, however, is to me the greatest of all, inasmuch as it gives the essence of the competitive spirit. After driving many, many thousands of miles I am as fond of the road as ever, as keen as the veriest novice to be upon my car and away. The utilisation of the road to hammer out the question as to who can cover a certain distance in the best time, with all the possibilities attendant on the driving—possibilities of good luck and bad, punctures or breakages, difficulties to be met and overcome—all this, *in competition*, goes, to my mind, to make up a grand sport. The spice of danger does not detract from, but adds to, the fascination.

I am afraid, however, that all this has departed. The true sport of road-racing is finished, and I look back longingly to the days of Charron and De Knyff, when cars *did* offer possibilities in their unknown vagaries, and troubles in a race did not mean that all hope of winning was gone. The regularity and speed of the fastest express train was not necessary, and the speed of ninety miles an hour was unknown.

If I really analysed my feelings, I daresay I should find that I am fond of the automobile *sport* rather than of automobile *speed*. My ideal race would be one of 500 miles between twelve cars of not more than 16 h.p., as nearly alike as possible—the contest, in fact, carried out on the lines of a race for half-raters.

Yachting men have solved the problem of obtaining real sport without great speed, and automobilism has yet to learn it. I am not sure that I *do* like racing on a large scale, whereby one is hurled through the air at an average speed of something more than sixty miles an hour. There is a certain amount of sport in it, I admit; but when in getting up in a race one has to take the precaution beforehand of leaving everything in order for the assistance of one's executors, the sporting spirit is rather damped by the possible prospects. And again, as I am now numbered amongst the noble army of Benedicts, I have the fact impressed upon me that it is not a fair sport that necessitates the risking of one's neck *every* time one participates; and—between ourselves—I am inclined to agree.

I can hear you asking me, Why, then, do I continue racing? And as an answer, I would remind you of the monotony of a life which offers nothing but a respectable staidness and, in the future, a comfortable old age. With me there must always be something in the distance which can be looked forward to as offering chances, with possibilities of success, over my fellow-men—no matter what the direction might be. At present this is satisfied by racing on an automobile; in two years' time (if I so long survive the strenuous pursuit) it may be in the emulation of the renowned Captain Nemo.

I am perhaps illogical; but then I am often accused of that, and I should be sorry to be an entirely logical and consistent person. So that if my reasons are not altogether conclusive and satisfactory, I am afraid I must leave you guessing.

Very sincerely yours,

CHARLES JARROTT

V

FROM MAJOR F. LINDSAY LLOYD, R.E.

(Secretary to the War Office Mechanical Transport Committee.)

April, 1904

MY DEAR FILSON YOUNG,

What are my ideas as to the military use of motor-cars? Naturally, my mind at once divides their use into two broad divisions—Peace and War; and although it may be, and usually

is, rightly said that we ought not to arrange for peace any military organisation which cannot be adapted or employed in war, yet I feel that in these early days of automobilism—and they are, after all, merely the early days of a movement whose future will be one of ever-increasing expansion and importance—though we can see the immediate and economic military use of the motor-car for peace, we are not so clear as to its value in war.

I therefore divide the two uses: Peace.—Already, even though little really has been done with the military motor-car, we hear the cry of the energetic staff officer, striving for the efficient control of his command, that he cannot get through his work properly without the assistance of motor-cars. This cry may be answered by the conservative that as four years ago—only a short four years—he was satisfied with the horse and the other ordinary means of transport, he ought to be able to get on well enough now with the same means. I doubt whether a really thoroughly energetic officer *was* satisfied—he did what he could; but I am certain he felt that he would have done more had he the proper means. Failing the proper means, he had to be satisfied with periodical and formal visits to outlying troops stiffened by dreary "memos," the constant source of trouble to himself and irritation to his subordinates.

With motor-cars at the disposal of a general and his staff nowadays personal attention can be given to all points in a command—there is no need of formal inspection. A morning will allow a general to, say, witness a brigade field-day twenty miles from headquarters, and be back in time to see how a colonel is conducting the field firing of his battalion. Every one of his staff are enabled, given that enough cars are provided, to give detailed and personal attention to the duties which are being carried out under their orders instead of—as in past years—directing the whole from an office.

For technical officers, too, such as the Artillery, Engineer, and Army Service Corps Commanders, the use of motor-cars is essential—yes, essential. I use the word intentionally, as I am convinced that no work is ever properly supervised unless it is supervised in person. The more technical and thorough our military training becomes—and it is daily becoming more technical and thorough—the more does personal supervision of

The next natural use of a car will be in the command of transport columns—moving from the railway to the advanced bases. Mechanical transport is bound to come for this purpose sooner or later, and when not mixed up with animal transport will prove a rapid means of locomotion. The officer in command of such a column composed, as I expect to see in future wars—especially in countries where roads exist—of mechanically propelled vehicles, will require a motor-car for his use to properly keep touch with the whole of it. Even where horsed wheeled transport is employed a car would be of the greatest value to the transport officer, enabling him to keep himself in touch with all that is going on along the whole long line of vehicles.

Beyond these uses it is difficult to lay down definitely a rôle at present for the motor-car in such wars as we are likely to be engaged upon. Of course, in European countries things are different, and undoubtedly there is an enormous rôle for the car, almost right up to the firing-line. Where roads exist cars and motor cycles will be used largely, I am sure, for keeping units in touch with one another, carrying officers and reports from the various sections of an army to its commander, and so relieving the mounted soldier from a large amount of orderly duty and making him free for his proper work of fighting. But with us, fighting as we usually do in wild and generally roadless countries, the car has not yet been brought to such a pitch of perfection where it can be counted on as a fighting machine.

There will undoubtedly be many uses to which it will be put by the intelligent officer, as was the case even in South Africa when the car was hardly out of the nursery, but I am considering it as a machine for regular use. The difficulties of a *self*-propelled vehicle in getting about in rough places are at present very great. That these will be got over in time, and that we shall see before many years self-propelled vehicles moving where any horse-hauled vehicle can go, I have no doubt whatever, but sanguine as I am of the great present use and still greater future value of the motor-car for military purposes, I am not so blind to its present disabilities to want to sweep the horse-drawn vehicle away altogether.

In fact, a maxim that should be impressed deeply into the mind of every intending user, not only of the motor-car, but of

any town without sacrificing what house-agents call the amenities. I am rid of the whole tribe of coachmen, saddlers, corn-dealers, smiths, and vets. I can catch me a train anywhere within fifteen miles when I please, and not when the Jenny's hind leg or Jack's cough is better; and if I visit, I do so as a free agent, making my own arrangements for coming and going. In all cross-country journeys I am from one to four hours quicker than the local train service. On main line routes I hold my own—in greater comfort than the railway can give me—up to forty miles.

But the chief end of my car, so far as I am concerned, is the discovery of England. To me it is a land full of stupefying marvels and mysteries; and a day in the car in an English county is a day in some fairy museum where all the exhibits are alive and real and yet none the less delightfully mixed up with books. For instance, in six hours, I can go from the land of the *Ingoldsby Legends* by way of the Norman Conquest and the Barons' War into Richard Jefferies' country, and so through the Regency, one of Arthur Young's less known tours, and *Celia's Arbour*, into Gilbert White's territory. Horses, after all, are only horses; but the car is a time-machine on which one can slide from one century to another at no more trouble than the pushing forward of a lever. On a morning I have seen the Assizes, javelin-men and all, come into a cathedral town; by noon I was skirting a new-built convent for expelled French nuns; before sundown I was watching the Channel Fleet off Selsea Bill, and after dark I nearly broke a fox's back on a Roman road. You who were born and bred in the land naturally take such trifles for granted, but to me it is still miraculous that if I want petrol in a hurry I must either pass the place where Sir John Lade lived, or the garden where Jack Cade was killed. In Africa one has only to put the miles under and go on; but in England the dead, twelve coffin deep, clutch hold of my wheels at every turn, till I sometimes wonder that the very road does not bleed. *That* is the real joy of motoring—the exploration of this amazing England.

But to revert to the Moral Aspect; and in continuation of some of my remarks on the *Kinfauns*. Have you noticed how the motor is the most efficient temperance advocate, and the only Education Act at present enforced, in Great Britain? A

horse in most harnesses does the work for which his driver is paid; and when the man is more than usual drunk the beast will steer him home. Not so the car. She demands of her driver a certain standard of education, the capacity of unflickering attention, and absolute sobriety. Failure to comply with her indent means death, mutilation, or fine in the shape of a heavy repair bill. There is no argument: there is no concession: above all, there are no carrots. She is a condition, not a theory. Think what her presence, in registered thousands, will mean to a nation which has been laboriously trained never to admit the existence of a condition if that condition conflicts or seems likely to conflict with any one of its theories! Even now I see improvement. There are on the twenty odd miles which divide me from the nearest town westward thirty-one or thirty-seven pubs. In front of each I used to find at least two unattended horses. Now there are fewer beasts outside, and those within are not so sodden. They keep one ear up the road; they set down their tankards; they leap from the bar; they run to their horses' heads. They break, if it be but for an instant, the habit of ages. What has wrought the change in our midst? Tracts? Blue Ribbons? The Fifth Standard? That would not be the Te-rewth. It is the Car—the Unexpected Car round the corner.

I have seen carriers, awake and erect on their seats by the hour, both reins in their hands and both eyes on their pair. I have seen the fat coachmen of the fat landaus and barouches that bumble round the country-side visibly driving—a thing which, the horses attested, they had not done for years. I have seen the whole of a hunting-field sit down and really ride their mounts. Some of them did it very badly, but they all tried. I have seen men walking on the road suddenly and accurately distinguish between their left hand and their right, and this not for political reasons, as a tenet of religion or as a form of sport, but automatically and almost as though it were the ingrained instinct of a highly organised civilisation. Seven years ago accuracy, precision, restraint, the idea of projecting one's imagination a hundred yards ahead of one's nose down an apparently empty road did not exist. It is the Car, my dear Young, that we have to thank for the quickened intellect, the alerter eye, the more agile limbs, and the less unquenchable thirst of our

fellow-citizens, as well as for the higher standard of decency now attained by our officially dumb companions. I know a rooster on the Heathfield Road who, but that he is honest, might be made constable over a trap. He can judge to a fraction the speed of every motor that comes his way, and since he has no tail to speak of he takes chances that bring the heart into your mouth. But he survives, and I do not doubt will be the sire of a line of double-breasted, facing-both-ways poultry. And there is a dog who was once bold against the bare legs of children and the skirts of nurses—the sort of ravening hound of whom his owner says, "It's only his play. He won't hurt you unless you show you're afraid of him." Last year my car caught him on the shoulder and hoisted him nearly as high as Sirius. He came down again quite well, thank you, but so changed—and so vastly for the better! He, too, will propagate polite puppies.

Thus do we all benefit by the Note of the Age, which is the motor-horn.

As the English mail is just closing and I want to go for a trip to Stellenbosch I will spare you the rest of the sermon. The subject is inexhaustible, but I am,

Yours ever considerately,
RUDYARD KIPLING

CHAPTER XIV

L. S. D.

The seamy side—Unprofitable comparisons—Upkeep of a light car—Upkeep of a steam car—The keeping of accounts—Things that are forgotten—A liberal estimate—Maintenance of a touring car—A doctor's car—Electric carriages and their cost—A legitimate comparison—The two great expenses—Petrol or Alcohol?—A year's expenditure.

THESE three letters represent in too many cases the seamy side of motoring. There is no doubt that the most serious hindrance to its pleasures is that they are expensive, and therefore tend to become restricted to people who need them least. A good deal of harm has been done by people who boast that their motoring costs them next to nothing and that, by some extraordinary method of arithmetic, it can be shown to be cheaper to drive a motor-car than to do nothing at all. Here again, as in the selection of a car, everything depends upon what the owner expects, what kind of service he demands. If a motor-car is kept as a substitute for the railway train, it will be a very expensive business; but it will not be so expensive as keeping a private railway train. If it is used as a substitute for a carriage and two pairs of horses, it will again be expensive; but it will not be so expensive as keeping a carriage and two pairs of horses. If it is used merely as a substitute for a single-horse trap, it will still be a recognisable item in one's annual expenditure; but it may, given very good luck, be not quite so expensive as a horse and trap. But if it is used as a substitute for morning strolls and afternoon walks only, it may not be very expensive, but it will certainly cost more than the walks.

So that it all depends upon what you want your motor-car for, and what you want to do with it. The very lowest sum for

which a motor-car can be kept and used is £50 per annum; but this involves the greatest economy, such as only using the car in fine weather, avoiding roads covered with loose, unrolled flints, and the undertaking of the entire care and supervision of the car by the owner himself. We will take the case of a little car costing from £150 to £200. Such a car would probably average thirty miles for every gallon of petrol consumed. With an average mileage of 100 miles per week the yearly mileage of 5,000 may be reckoned; and this is about the lowest mileage upon which (on purely economical grounds) it is desirable to use a motor-car at all; a pony and trap, if the means of upkeep are cheap, would do for anything less. But taking 5,000 miles as a basis, the very lowest expenses that I can estimate would be as follows. I may say that all the tables in this chapter are founded on actual experience.

	£	s.	d.
Petrol	11	10	0
Lubricating oils and grease . . .	3	10	0
Insurance	4	0	0
Occasional help in cleaning . .	5	0	0
Tyres	9	0	0
Licences	2	7	0
Repairs and replacements, including charging and renewal of accumulators .	8	10	0
Stabling	5	0	0
Depreciation	15	0	0
Total	£63	17	0

This, to be sure, is a little more than £50; but against the balance may be set the sum gained either if stabling can be had for nothing or if depreciation is not charged, although it should be remembered that depreciation is a proper and important charge against the cost of a motor-car, particularly if it is a small and cheap one, as there is practically no second-hand market for these cars. Only in the most expensive and newest types of motor-car can depreciation be ignored, because in such a case it is possible, by ordering a high-powered and expensive car of first-class repute beforehand and waiting for delivery, to use it for a year and then sell it at a premium. I will now give an estimate for the upkeep of a light steam car of about the

estimate. An interesting table, for example, was recently contributed to the *Autocar* by a member of the Scottish Automobile Club. His figures referred to the cost of running a 10 h.p. car for 7,065 miles, and are as follows:—

	£	s.	d.
Light, oils, and grease	3	5	6½
Petrol	22	12	8
Repairs and replacements . . .	12	9	11
Tyres	27	15	3
Sundries, licence, stabling, and washing .	14	10	11½
Total	£80	14	4

The halfpence in this estimate are significant. They are perhaps explained by the nationality of the owner; but in any case, they indicate the care taken to cut down the statistics to the lowest possible point. No charge is made either for insurance or depreciation, and in any case the charge for stabling and washing seems unusually low. But even so, and taking this as a fair example of how little a car can be run on, there are many expenses incidental to the keeping of a motor-car which do not appear, and could not very well be reckoned in such an account. These consist of expenses on the road—a far from small item. There are all kinds of petty expenses incidental to travelling in a motor-car, which, perhaps, are not seriously considered at the time, but which at the end of a year amount to a very substantial sum. This motorist employed no servant, and was his own motor-man. What, then, of all the tips at roadside hotels, the shillings given for a can of water here or for washing there, the hotel and garage expenses incurred—perhaps contrary to the original intention—the cost of carriage and travelling expenses in connection with repairs and renewals? These may seem small matters, and in this particular case may not have amounted to a great deal, but in the average case they would certainly occur, and would amount to at least a sovereign for every thousand miles run. Nor can there be any allowance made in such tables for what may be called the human nature of motoring, the purchase of all kinds of alluring accessories, the little extravagances indulged in at the automobile exhibitions, the cost of special clothing and rugs, the little electrical devices adopted and dis-

I will now give another table covering the cost of running a 20–24 h.p. car which is used for touring on the Continent as well as in England—in the use of which economy is not allowed to interfere with pleasure, and for the care of which an expert mechanic is kept. The services of such a man can seldom be secured for less than £3 a week, but as he would be able to undertake all adjustments and minor repairs, the repair bill at the manufacturer's ought to be considerably lighter than if a less competent man were kept. Hotel expenses are, of course, not charged in this table, but the hotel and travelling expenses of the mechanic are charged. The expenses in this table are charged for an annual average of 10,000 miles.

	£	s.	d.
Petrol	48	15	0
Repairs and replacements	30	0	0
Lubricating oil and grease	7	0	0
Tyres	45	0	0
Insurance	10	0	0
Licences	2	7	0
Extra insurance on motor-house	2	10	0
Lamps, carbide, etc.	5	15	0
Sundry accessories, including special clothing, glasses, rugs, etc.	7	10	0
Mechanic's wages	150	0	0
Ditto, travelling expenses	18	10	0
Ditto, clothing	10	10	0
Ditto, licence	2	2	0
Cost of shipping car, foreign dues, etc.	10	0	0
Carriage on repairs and stores	2	10	0
Annual overhaul	15	0	0
Ignition expenses, cleaning cloths and motor-house sundries	5	10	0
Total	£373	9	0

I think this is a pretty low estimate for what may be regarded as the most luxurious kind of motoring, although if a higher-powered car be kept the cost will be greatly increased; and the cost of keeping and using freely a 40–50 h.p. car cannot be much less than £500 a year, and may be a great deal more. But it must not be forgotten that the more freely the car is used, and the more it consequently costs in upkeep, the greater

is the sum which must be credited to its account as saved in expenses incidental to other means of travel. It is quite conceivable that the possessor of a motor-car who spends £300 a year upon its upkeep may save an annual sum of not far short of that amount; and if he was formerly a devotee of the stable and has given up several horses to make room for his new possession, it is likely that he would save a good deal more. But, of course, in the region of mere luxury the cost of upkeep, and what is saved or spent by the use of a motor-car, becomes of very little importance.

For medical men, who have to cover long distances daily in the course of their practice, there seems to be a very real economy of time and money in the use of a motor-car. The following interesting comparison was contributed to a recent number of the *Autocar* by a country doctor who had substituted a motor-car for his single horse and trap:—

HORSE EXPENSES.	Per year. £	s.	d.
Horse expenses (per week 15*s*.—this includes food, hay, and straw)	40	0	0
Shoeing	4	0	0
Veterinary account	2	0	0
Harness repairs, average	1	10	0
Carriage repairs, average	12	10	0
Coachman, 26*s*. per week	67	0	0
Livery, boots, whips, sponges, etc.	3	0	0
Total	£130	0	0

MOTOR-CAR EXPENSES.	Per year. £	s.	d.
Tyres, average cost	20	0	0
Petrol for 100 miles a week (this is probably more than the horse has done) at 1*s*. per gallon for 25 miles	10	10	0
Repairs average about	12	10	0
Youth at 15*s*. per week	40	0	0
Sponges, leather, etc.	1	0	0
Total	£84	0	0

With regard to the keeping of carriages in town, there is, for those who make use of them freely, a real economy in the use

of an electric carriage, costly as these undoubtedly are to buy and run. The admirable organisation of the Electromobile Company and the City and Suburban Electric Carriage Company abolishes all trouble in the keeping of an electric carriage in London, and provides the greatest possible degree of convenience. I will now give some comparative tables showing the difference in cost between the keeping of carriages for town use and the keeping of electric carriages. It should be remembered, however, that the only people to whom the keeping of an electric carriage is really an economy are those who, for a part of the year at least, use their carriages morning, afternoon, and night; for which purpose at least two pairs of horses are necessary, as well as the services of a coachman, an under-coachman, and a helper.

The City and Suburban Company undertakes, for a monthly charge of £18 15*s.*, to house and supervise an electric carriage; to supply as much electric current as the carriage can use, and to make all adjustments and renewals of working parts, including the care and inspection of the batteries; to wash, clean, and lubricate, and to supply all cleaning materials; and to insure against fire as well as against damage to the carriage and injury to third parties. They also provide an all-day and all-night service—everything, in fact, except the maintenance of pneumatic tyres. Taking the first cost of an electric landaulette at £850, including tyres, we have the following expenses:—

	£	*s.*	*d.*	£	*s.*	*d.*
Interest on capital @ 3 %				25	10	0
Wages of driver				100	0	0
Clothing				10	0	0
Licences				4	9	0
Pneumatic tyres				10	0	0
Inclusive charge for upkeep	225	0	0			
Deduct: reduction of £5 per month allowed when carriage is out of use for not less than thirty consecutive days, provided previous notice has been given, say, three months	15	0	0			
				210	0	0
Depreciation @ 10 %				85	0	0
Total				£444	19	0

We will now take the cost of keeping a carriage in town, with two pairs of horses and harness as described, the first cost of which we will put at £500, although it might conceivably be a little less, and is often a great deal more.

	£	s.	d.
Interest on capital @ 3 %	15	0	0
Stabling and accommodation of coachmen and helpers	125	0	0
Wages of coachman, under-coachman, and helper	175	0	0
Veterinary surgeon	21	0	0
Liveries, clothing, and licences	62	10	0
Stabling expenses for four horses, including brushes, clothing, forage, and cleaning materials	250	0	0
Coach builder and saddler	21	0	0
Depreciation @ 10 %	50	0	0
Insurance	7	10	0
Total	£727	0	0

There is a considerable difference between these amounts; and there is also a difference between the security enjoyed by the owner with regard to what is called the "reliability" of the two forms of carriage. The electric carriage does not go wrong; that is to say, if there is anything the matter with its batteries a new set will be supplied while the necessary repairs are being made; but it is far from certain that the horses would not suffer from ailments which would render them periodically useless. I have, however, charged nothing for the cost of jobbing in case of the breakdown of any of the horses.

It may be objected to this comparison that comparatively few people who use carriages in London now keep their own horses, carriages, or stabling, but job them by the month or year. Here again, however, I find the cost of jobbing an electric carriage to be less, though not so much less, than that of jobbing a carriage and horses, the work of which it performs. If we take as a basis for a new comparison the residence in town of the user for six months only in the year, the figures will be as follows. The estimate for the carriage and horses has been furnished to me by a large firm of West End jobmasters.

Cost of jobbing an electric carriage for six months, including driver and all expenses, £330.

Cost of jobbing one carriage, two pairs of horses, first and second coachman and a helper, including livery, for six months, £365. An electric carriage can be hired for £500 a year, while the cost of the necessary horses and carriages to do its work would, according to the estimate with which I have been furnished, be £714 per year. The cost of jobbing a single brougham with one horse and coachman is £231 per year; and one horse could not do half the work of an electric carriage, the equivalent of which, it is generally agreed, is four horses with their necessary stable attendants. So that even in these expensive and luxurious matters the motor-car more than holds its own as regards economy.

There is no doubt that a motor-car could be kept under ideally cheap conditions but for two things—petrol and tyres. The man who is his own mechanic and is content with a strong, simple, single-cylinder car, could reduce his running expenses to a very few pounds a year if he had not to face the heavy expense of petrol and pneumatic tyres. The practical monopoly which exists in petrol has raised its price to an absurd point, and it has become a question whether some other source of explosive power should not be sought which would be free from the commercial limitations by which the use of petrol threatens to be limited. The movement in favour of using alcohol instead of petrol needs only to be helped by a slight alteration in the excise laws to make the whole matter a very much simpler one and to put the motor industry on a much sounder basis than it enjoys at present. Alcohol could be cheaply produced in this country and in Ireland; it is, bulk for bulk, a more powerful motive agent than petrol, and it is cleaner and simpler in its action. Paraffin, given a motor properly designed to use it, is, of course, by far the cheapest and most efficient material for this purpose, but the fact that there is only one kind of car sold in England which uses paraffin as an explosive agent seems to indicate that the ideal conditions of its use have not yet been discovered. A really efficient and automatic steam car burning paraffin costs less to run than a petrol car; but the prejudice against steam cars in this country dies hard, and the capital sunk in the manufacture of petrol cars is a formidable opponent to the development of steam.

With regard to pneumatic tyres, there is one and only one certain way to be rid of the expenses connected with them, and that is—not to use them. The best of them are liable to be cut to pieces on a patch of unrolled flints, and there is no avoidance of the heavy expenses involved in their repair and replacement. But the wise man who is determined on economy will use on a light car solid rubber tyres; only he will see that the car has been made specially for their use. For speeds under twenty miles an hour they are quite trustworthy, and their life on a light car is long. On large and heavy cars they are practically out of the question; but for the poor man's car they are essential to economy, and are amply sufficient for comfort, if not for luxury.

As it may interest some of my readers to see exactly of what items the cost of maintaining a small motor-car is made up, I give here a copy of a scrupulously kept cash account relating to the running of a small single-cylinder petrol car for a year. This account has been furnished to me by the kindness of Mr. F. W. Buckmaster. The distance run during the year was 8,000 miles, and the car was taken out in all weathers.

1903.		£	s.	d.
Mar. 9.	Petrol	0	2	6
„ 17.	„	0	2	6
„ 18.	Stauffer's grease	0	2	0
„ 24.	Lubricating oil	0	4	6
April 7.	Petrol	0	2	6
„ 12.	„	0 0	2 2	0 6
„ 14.	Repairs, result of collision	2	7	6
„ 30.	Petrol	0	3	0
May 6.	Spare links for chain, driving	0	4	0
„	Fitting gauge glass to petrol tank	1	9	0
„	„ extra tool carrier	0	5	6
„	Repairing chain and adjusting	0	8	6
„	Special bracket for front lamp	0	7	3
„	Altering cylinder head for D.D. plug	0	7	9
„	Extra bolts	0	3	0
May 18.	Recharging accumulators and adjusting engine parts generally	0	14	0
„	Two front lamps, silver plated	0	12	6
May 22.	Set of mudguards and cost of fixing	5	0	0
„	Two spare valves, complete	0	7	6
„	Specially fitted side baskets	1	12	6

1903		£	s.	d.
May 22.	Petrol	0	2	6
May 29.	„	0	3	2
„	Fitting exhaust bye-pass	2	0	6
„	New wire to throttle and repair petrol cock	0	4	9
June 15.	Oil	0	5	3
July 1.	Single-tube tyre	4	0	0
„ 3.	„ repair	1	15	6
„ 9.	„ „	0	1	3
July 15.	„ „	0	5	3
„	Repair water-pipe	0	4	6
July 17.	Recharge accumulators	0	3	0
„	Single-tube tyre, repair	1	15	6
„	„ „	0	1	6
June 20.	Petrol	0	3	2
July 1.	„	0	6	4
„ 3.	„	0	6	4
„ 6.	„	0	6	4
„ 8.	„	0	2	4
„ 10.	„	0	6	4
„ 16.	„	0	6	4
July 24.	„	0	3	2
„	New wire to ½-compression valve	0	2	9
„	Repair water-joint	0	4	6
July 25.	Petrol	0	3	2
„ 27.	„	0	6	4
July 30.	„	0	6	4
„	Single-tube tyre, repair	1	18	6
Aug. 3.	Single-tube tyre, second-hand	2	7	6
„	Repair pump	0	3	3
„	„ carburettor	0	8	6
„	Straightening front axle and fitting cones and balls	2	13	0
„	Fitting new chain-wheel on back axle, new emergency brake, labour, etc.	3	14	6
„	Petrol	0	4	8
Aug. 6.	„	0	3	0
„ 10.	„	0	6	0
„ 14.	„	0	5	4
Aug. 24.	„	0	6	0
„	Single-tube tyre repair	1	4	0
Aug. 28.	Petrol	0	9	0
Sept. 4.	„	0	5	3
„	Single-tube tyre repairs	0	9	6
Sept. 5.	Petrol	0	2	4
„ 8.	„	0	7	0
„ 15.	„	0	2	4
„ 25.	„	0	4	8
Oct. 2.	„	0	7	0

		£	s.	d.
1903.				
Oct. 8.	Petrol	0	3	0
"	Single-tube tyre	3	15	0
Oct. 2.	"	4	0	0
Sept. 9.	Oil	0	5	3
"	Stauffer's grease	0	1	6
Nov. 4.	Petrol	0	3	0
" 20.	Single-tube tyre repair	0	9	6
Aug. 24.	New cone and balls to front wheel	0	3	6
"	Repair wires and terminals	0	4	3
"	Oil can	0	2	6
"	New driving-chain	2	12	0
"	General adjustment	0	9	6
"	Sparking plug	0	1	0
Sept. 8.	General adjustment	0	13	0
Sept. 11.	Repair water-tank and radiator	0	8	6
"	Recharge accumulators	0	4	9
Sept. 12.	Repair petrol pipe	0	1	9
Oct. 8.	Recharge and repair accumulators	0	7	3
"	Taking off cylinder head, repairing and refixing	3	0	6
Nov. 15.	Grinding in valves, repairing petrol pipe	1	2	0
"	New wire to ½-compression	0	9	6
"	½-compression cock and fixing	0	7	3
"	Repacking cylinder head	1	8	0
Nov. 18.	New cylinder	10	0	0
"	Cam wheels	0	15	0
"	Labour taking down and refitting	9	12	6
"	Recharge accumulators	0	1	6
Dec. 12.	Repair steering gear and radiator	0	15	6
" 29.	Petrol	0	2	4
1904				
Jan. 4.	Petrol	0	4	8
"	Special fixing for rear lamp	0	3	6
"	General adjustments	0	9	0
Feb. 27.	Recharging accumulators	0	1	0
"	Petrol	0	9	4
Mar. 30.	Sundry repairs	1	4	6
"	Recharging accumulators	0	2	0
"	Sundry purchases of petrol while away from town for a period of twelve months as per log-book (other petrol was purchased in town)	7	1	4
"	Tyre repair outfit . . . 10 6			
"	Rubber string, solution . . 4 0	0	14	6
	Total	£97	17	1

Which is analysed as follows:—

	£	s.	d.	£	s.	d.
General repairs	47	17	3			
Additions	11	0	9			
Tyres	22	17	6			
Petrol	15	3	1			
Oil and grease	0	18	6			
				97	17	1

Or, $2\frac{7}{8}d.$ per mile for 8,000 miles.

Another way of stating this account is to show what was paid for the car at the beginning of the year, and what it was sold for. Thus:—

	£	s.	d.
Original cost of second-hand car . . .	125	0	0
Cost of running for year	97	17	1
	222	17	1
Deduct amount realised by sale of car . .	70	0	0
	£152	17	1

Or, $4\frac{1}{2}d.$ per mile for 8,000 miles.

With regard to this account, it should be noticed that the £11 for additions is not an absolutely necessary charge; and also that for this particular kind of car an annual mileage of 8,000 is too much—more than the car is intended for. A different kind of tyre would also, I think, have been more suitable for such heavy work, and would not have cost so much for repairs and renewals. Moreover, the charge of £20 for the purchase and fitting of a new cylinder, owing to the cracking of the head, is purely an accident of the peculiar circumstances. But that the car was a second-hand one (although it had only been run about one hundred miles when Mr. Buckmaster bought it) I have no doubt that the makers would have replaced the cylinder, which was obviously of defective manufacture. Seventy pounds would be, therefore, a much more usual figure than £97 for the running of such a car for 8,000 miles; and that works out at just over *2d.* per mile. The cost of petrol for the 8,000 miles, even when it was bought at high retail prices, works out at less than $\frac{1}{2}d.$ per mile.

CHAPTER XV

THE MOTOR-CAR ABROAD*

An ideal country for touring—How to get there—The necessary documents—Custom-house hours—Inhospitable Italy—A matter of detail—The worst roads in Europe—Austria and Germany—The cost of motor-touring on the Continent—History and geography at a glance.

THE delights of motoring can be enjoyed nowhere so fully as in France, and it should be the ambition of everyone who has a motor-car to carry it as soon as possible across the Channel. In England our roads are usually narrow and winding; the speed limit is low, and the police ever on the watch; bad weather often interferes with sport; good garages, where the services of competent mechanics can be had, are rare; hotel keepers' charges are high. France, as far as automobilism is concerned, is twenty years ahead of England. The French roads are the best in the world. The great *routes nationales* might have been engineered with a prophetic eye to the new locomotion, so straight and smooth are they, so gently curving, so delicately graded. Motoring in France is not a pastime of the rich; it has become part of the life of the people. In the remotest villages, and in the humblest inns, *essence* can always be bought; capable mechanics abound; and the hotel keepers, alive to their own best interests, charge nothing for putting up a car for the night.

To take a car to France is simple enough. A very easy and cheap way is to send it direct to Boulogne by the Bennett Steamship Company, from Chamberlain's Wharf, Tooley Street, near the Surrey side of London Bridge. The boats of this company sail three times a week, and thirty-five shillings is the freight payable. The owner can either voyage to Boulogne by

* This chapter has been kindly contributed by Mr. and Mrs. C. N. Williamson.

the same ship that carries his car, or he can cross next day by the ordinary Folkestone-Boulogne route, to find the car landed on the quay at Boulogne. The customs formalities on entering France are simple, though there may be some hours' delay if the functionary charged with such matters should happen to be away at luncheon. Usually half an hour should be enough to clear the car. It is weighed; a description of it is written out, a money deposit is paid (the amount depending on the weight of the car), and papers are delivered to the owner certifying that he has paid a certain sum which will be given back to him at any of the customs stations on the French frontier should he leave the country within a year.

So much for the first step. To travel safely in France the foreign motorist should next provide himself with the two documents without which it is illegal to drive a motor-car on the French roads—a permission for the vehicle to "circulate," and a permit for the driver. A foreigner may, if he likes, ignore the laws of France, and drive his car without having any papers whatever. He may never be challenged, or he may be called upon to halt as he is rolling away from the quay where he lands; and in case of an accident the absence of papers would be looked upon by the police as a grave contravention of the law. It is better, therefore, to go to the trouble of getting the necessary permits, especially if it is intended to pass from France into other countries; for a French permit is recognised in Italy, in Germany, and practically everywhere. The Automobile Club of Great Britain is engaged in negotiations with the custom-houses of France, Belgium, Switzerland, and Italy, to facilitate the entry of members' cars into those countries, but the only country with which arrangements are actually completed is France; and members of the club, by depositing money in London, can receive papers which ensure the rapid settlement of the custom-house regulations. An international understanding among all countries would make motor touring on the Continent easier than it is at present. Application for the permits must be made on stamped paper in a prescribed form to the Prefect of the Department in which the driver begins his journey. The application can be sent in advance from England, thus lessening the delay on arrival. The various regulations, wonderfully precise and elaborate on paper, are

liberally interpreted by the courteous officials of the Service of Mines, who put the driver through a simple examination, mounting on to the car with him, directing him to turn right and left, noting how he behaves in traffic and how quickly he can stop his car. In twenty minutes the business is over, and the papers are delivered. The owner must not forget, if he is leaving France for a little while and means to return, to furnish himself with a *passavant descriptif*, issued by the office of the custom-house at which he goes out. Without this, he may be called upon to pay the duty the second time.

In France and most other European countries the custom-house officers are always civil to foreigners; but there are certain regulations well calculated to rouse ill temper in the breast of the touring motorist. For example, the office-hours in France are from 8–12 a.m. and 2–6 p.m. in winter; from 7–12 a.m. and 2–7 p.m. in summer. Should you arrive at a frontier during the hours sacred to luncheon and repose, the guard on duty will tell you that the office is closed, and that no papers can be issued. If in these circumstances the foreigner swears loudly and condemns with vigour the institutions of France, he is doing an unwise thing, for he hardens the heart of the officials, and they will do all they can to impede him. With French and all other officials, suavity carried to the limit of unctuousness will usually pay best. More serious than the long suspension of business in the middle of the day, however, is the fact that the custom-houses stop work altogether at an early hour of the evening. Incredible as it may seem, you cannot get into Italy at all if you arrive on a motor-car after eight in the evening without papers. The guards on duty will suggest to you gravely that you should return to the nearest inn of the country you have just left. This once happened to the writers at the Italian custom-house at Grimaldi, just beyond Mentone. It was nine o'clock at night. The men were inexorable. The office was shut; the *chef de douane* had gone away; there was no one who had power to receive money or issue papers. Inhospitable Italy shut her door in the face of the stranger. There was nothing for it but to leave the car by the roadside and walk a mile to the village of Grimaldi, where by asking questions we found the restaurant where the *chef de douane* usually dined. Fortunately he was of a kindly disposition and

consented to return to the frontier, open his office, and issue the necessary papers. This he did of grace and not by duty; a more stubborn official might have refused; in which case there would have been no other course than to return to Mentone.

The scrupulous attention of the French officials to matters of detail may sometimes act against the stranger. Recently we were again leaving France by this same route—the sea road from Mentone to Ventimiglia. At the last French post, at the Pont St. Louis, we were commanded to halt, and asked for papers. We had none; we had started from Monte Carlo and were bound for Venice, for Dalmatia, for Switzerland and Germany, for England. We had no intention of taking the car back to France, and therefore did not ask for a *passavant.* The *douanier* was disconcerted, retired to consult his superior, and returned with the demand for 10 centimes, fee for the privilege of quitting France. We made the blunder of not asking for a receipt for that penny, and for this, later, we suffered. At the Italian custom-house a little beyond, we paid 112 lire deposit, received our papers in due form, and went on to Ventimiglia. Here, instead of pursuing the direct sea road to San Remo and Genoa, we turned up the beautiful valley of the Roya, and as we had towed for several miles up steep hills the disabled car of a friend, darkness overtook us in the depths of the gorge. Suddenly the lights of a town shone out of the night, custom-house officers appeared in the road, and we were ordered to halt. It was the town of Breil, and here, for the distance of nine kilometres, the road ran again on French soil.

Now began the difficulties. Our Italian papers were useless for France, and we had no *passavant.* We explained the affair of the penny paid at the Pont St. Louis. "Then you have a receipt for the 10 centimes?" asked the chief, seeing at once a way out of the coil. "Unfortunately no," we answered. "It had not seemed necessary to trouble the official for a receipt for so small a sum." The *chef de douane* looked grave. "As a man," he declared, with a courteous bow, "I believe you implicitly; as a functionary"—he puffed out his chest—"I am compelled to doubt your statement." We proceeded to argue the point with this dual personality. Could we not pay the deposit and receive it back again nine kilometres further on?

Impossible: it was after office hours, he could not issue papers after the bureau was shut for the day. Then what did he propose: that we should stay all night upon the road? The functionary was moved. "You place me," he declared, "in a deplorable position. You force me to seem discourteous to foreigners and hostile to automobilism. I am neither." Suddenly he had an idea. It was informal: it was not part of his duty; yet it could be done. He could send someone with us on the car to Fontan (where the road passed again into Italy), someone who could vouch that we were only passing through. A youth slouched out of the darkness and mounted into the car. We went forward again, showering thanks upon the resourceful *chef de douane* of Breil. Of course, this meant a long delay and a handsome *pourboire* to the youth; and all because we had not taken a receipt for the penny.

If the roads of France are the best in Europe, those of Italy are the worst—except, indeed, in Spain, which has practically no roads at all where motor-cars can pass. Here and there in Italy—notably in the province of Venice—there are stretches of smooth, good road; but in Piedmont, and even near great centres like Milan, the only idea of road mending is to tip masses of flint upon the highways, and leave the traffic to grind them in. The beautiful road from Pavia to Milan has a detestable surface; and the straight way north out of Milan to Bellagio is more like a torrent bed than a high road in a civilised country. In Italy, too, the rule of the road changes with perplexing suddenness. Out in the country you keep to the right, but at some undiscoverable point in the outskirts of Milan traffic goes to the left, and you find yourself driving in crowded streets on the wrong side of the road.

In Italy motor-cars are still rare. Peasants will leave their ploughs and run across the fields to get a near look; even in Milan an eager crowd gathered round the door of the hotel to watch our preparation for a start. This rareness of automobiles means, of course, that horses and other animals are little used to them; and in Italy one must drive with the utmost caution. Not only is every horse a possible danger, but mules, donkeys, yoked oxen, even yoked cows, show in the most energetic way their dislike of the new locomotion. Skill in steering and quickness of judgment are demanded at every

moment. Many of the country carts are long, and as the first impulse of the horses or oxen that draw them is to get into the ditch at sight of a motor-car, the result is that the cart is turned across the road, and collisions are avoided with the utmost difficulty.

In Austria and in many parts of Germany the horses and other animals are as easily frightened as they are in Italy. In nine cases out of ten the carters are fast asleep in their carts, to wake only at the blowing of the horn when the motor-car is close to them. Then follows a wild clutching of the reins, perhaps a quick stroke of the whip, and the animals, instead of being soothed, are startled still more. On roads like that from Cortina to Toblach, with brusque turnings and precipitous drops, a car must be driven with the extreme of caution, and the horn should be constantly sounded. Recently a service of motor omnibuses was started on this road. Accidents followed, and the local opposition was so strong that a petition to the authorities was followed by a suppression of the service.

Usually the Austrian and German roads are good. The Austrian customs officials are precise and slow in their dealings; and the tax on cars going into the country is double that demanded in France and Italy. "Put money in thy purse" is a necessary injunction when going into Austria. In Germany, on the other hand (a country where officialism is rampant), the customs officers are strangely lax about automobiles. There is a tax of 8 marks per 100 kilogs., but often there is no one to demand it, and you sail in duty free. Sometimes, indeed, you cannot see a custom-house on a German frontier; and you enter and leave the country unquestioned, untaxed. If, however, you intend to stay any length of time within the empire it is best to apply to the Chief of Police in the first important town you come to for the German equivalent to the *permis de conduire*, which is readily granted on production of the corresponding French document.

The expenses of a motor-car tour on the Continent are considerable, depending, of course, in large measure, on the size of the car and the distance covered. Nowhere in France, within our experience, is any charge made in hotels for garage. Petrol is cheaper, too, in France than in other countries. In France it is 55 centimes a litre; in Italy, 90 centimes; in Austria, 70

pfennig. In Italy some hotels charge 2 lire a night for garage; the same sum is charged at Mestre, where cars are put up while their owners are in Venice; while in Innsbruck the exorbitant demand was made of 4 marks a night. Expenses are reduced by membership of the Touring Club de France, the Touring Club Ciclistico Italiano, and the touring clubs of other countries. True, it is often only the second-rate hotels that are affiliated to these societies, but by using them a saving of from ten to twenty per cent. on hotel bills may easily be made.

The pleasures of motor-car touring on the Continent can scarcely be exaggerated. No one who has once tasted them can willingly travel again in any other way. There is the delight of speed, the delight of the unexpected, the satisfaction of the deep craving for life on the open road. To be dragged across the Alps by a locomotive, shut up in a stuffy, dirty box, can give little real pleasure; but to climb in a motor-car in a few hours up from the roses of Monte Carlo to the pines of San Dalmazzo, to the cold snowfields of the Col di Tenda, and then to rush down from winter to spring again in the pastures of Piedmont—this is an experience that lives for ever in the memory. What, again, can the mind of man devise more joyous and exhilarating than a run northwards from Venice into the jaws of the Alps, up to the sweet-smelling pines, down again to the green Pustherthal, thence up and up the steep gradients of the neglected Brenner, to swoop down at last upon noble Innsbruck? It is history and geography at a glance. In a few crowded hours scented Italy gives up its secret; the North whispers to you through its murmuring pines; the pageant of Rome, of the Middle Ages, pass before your wondering eyes. Or if the Alps be not great enough, there are other worlds to conquer and countries to explore, where, perhaps, your motor-car is the first that has been seen. The fringe of Europe offers many excitements; and in a drive along the Dalmatian coast to rose-pink Ragusa, and up the marvellous road that leads from Cattaro into the skies where dwell the mountain warriors of Montenegro, the adventurous motorist will find thrills and delights enough.

CHAPTER XVI

THE OPEN ROAD

The home of the motor-car—A quickened life—The freedom of the roads—Journeys by stages—A voyage through history—In Roman footsteps—The divisions of England—Subtle changes—Resident and stranger—The invasion of an island—The taming of monsters—An early morning journey—The scenery of the dawn—Wine of the gods—A pause by the roadside—An apparition—A monster at large—The man with the oily face—The breaking-in of the new force—A test of the heart—Incidents in a motor race—A momentary commotion—The workers—The bondage of the road—A generation of ghosts—The Road to Ireland—A road with a purpose—Telford and his monument—The despoiler of roads—The company of the telegraph wires—Where all roads must end.

FIRE IN THE HEART OF ME, MOVING AND CHATTERING,
  YOUTH IN EACH PART OF ME, SLENDER AND STRONG,
DEATH AT THE FOOT OF ME, RENDING AND SHATTERING,
  LIGHT AND TREMENDOUS I BEAR YOU ALONG;
UP TO THE BROW WHERE THE LEVELS GO WEARILY,
  DOWN TO THE VALE WHERE THE GRAVELS GIVE SPEED,
HOLDING IT, MOULDING IT, SCOLDING IT CHEERILY,
  SLAVE TO YOUR PURPOSE AND SIGN OF YOUR NEED.

SLENDER THE SPOKE OF ME, DRIVING UNCEASINGLY,
  DREADFUL THE YOKE OF ME, MIGHTY THE STRAIN.
YET SEND ME NOT WHERE THE WORK LESSENS EASINGLY,
  GIVE ME THE LIFT OF THE ROADWAY AGAIN.
FEAR, THEN, NO HILL THOUGH IT RISE TO FUTURITY,
  HEED NOT INFINITY; BE NOT PERPLEXED;
SOON AS ONE ÆON HAS GONE TO OBSCURITY,
  HEY, BUT I'LL RALLY YOU INTO THE NEXT!

G. STEWART BOWLES, *The Song of the Wheel.*

THE true home of the motor-car is not in garage or workshop, showroom or factory, but on the open road. There it comes to its own, there it justifies itself, there it fulfils its true and appointed destiny. Like a captive lion or a savage shown at a fair, it makes a poor enough appearance out of its true environment; and when we see it quivering at a standstill or

fretfully hanging in the crowded lanes of street traffic we sometimes think very poorly of it. But away from these entanglements it comes into the noble kingdom of which it has so lately captured the throne. The miles, once the tyrants of the road, the oppressors of the travellers, are now humbly subject to its triumphant empire, falling away before it, ranking themselves behind it. The wand of its power has touched the winds to a greater energy, so that the very air it consumes is crushed upon it with a prodigal bounty, sweetened with all the mingled perfumes of the fields and the seasons. It flattens out the world, enlarges the horizon, loosens a little the bonds of Time, sets back a little the barriers of Space. And man, who created and endowed it, who sits and rides upon it as upon a whirlwind, moving a lever here, turning a wheel there, receives in his person the revenues of the vast kingdom it has conquered. He lives more quickly for its vitality, drawing virtue and energy from its ardent heart; and if it be true that the capacity of life in each of us be limited not by time but by quantity, and that the mysterious engines of our flesh and spirit are set to endure, to enjoy, to see, to understand, to know, to live only up to a finite limit, then man's days, being faster and more crowded, will be fewer; and we shall find that what we received as a gift we shall be called upon to pay for out of our scanty store of years.

II

But even if it should threaten to rob us of a few of the melancholy days of old age, this new slave of ours has won back for us the roads. "The nerves and sinews of the land," Mr. Strachey has finely called them; and they are like nerves and sinews long disused, that are beginning to twitch and swell again with the message of life. Already on the great main roads the thrill of vitality has been felt. Old inns, that had long slumbered in a kind of ruinous trance, are beginning to wake up again, to bestir themselves, to be prosperous. Old men and women, keepers of shops left high and dry by the ebb of custom, who had thought to end their days in poverty or the workhouse, are here and there, to their profound astonishment, finding themselves afloat on the rising tide of prosperity. It is due not only to the direct influence of the motor-car, of course,

but to the new impulse of movement, of travel, and of intercourse of which the motor-car is at once the agent and the herald.

And out on this world of roads the traveller on a motor-car enters into possession of his country in a new way. In railway travel only two points are of real importance—the points of departure and of arrival; all the rest is but an accessory of the railway, a panorama of embankments and cuttings and curves at which we give a mere glance now and then. Things seen are seen only in their relation to the railway, of which, with its manifold and tremendous organisation, we can never be quite unconscious. It absorbs our individuality so that we are whirled along in an embarrassing cloud of companionship; all our fellow-travellers, the guards and enginemen, the clerks in far-away traffic offices, the signalmen reading by their cabin fires, the invisible and scattered army of cleaners, turners, shunters, lampmen, platelayers, and carriage inspectors, are all conspiring and collaborating in our punctual journey; and in such a degree that if thought or will-power could be confined and controlled in bulk, the train would need no other engine than the labours and wishes that are concentrated upon it.

But the road sets us free from this marvellous complexity of thought and mechanism, allows us to follow our own choice as to how fast and how far we shall go, permits us to tarry where and when we will. Moreover, it restores to our journeys their true value and importance, making them not a matter merely of departure and arrival, but of deliberate and conscious progress, in which every mile, every yard, is of equal importance with the beginning and the end. To walk by road is to taste this deliberation of travel in its full flavour, and to make of each footstep a stage in the journey; by motor-car we lose the extremely minute detail of the road, but cover it in spans so much greater that the sense of passage is vastly increased. And this, I think, is the supreme charm of this kind of travel; that it takes us from one world to another, not as the railway takes us, sealed up in an envelope containing ourselves and our environment, but open to, and conscious of, the things that connect those worlds with each other, so that we see the change coming and know how it has come. We do not shut our eyes in the plains to open them again on the mountains. We feel the road rising under us; we pass from the shelter of the

valleys to the winds of the upland; we leave the placid land of willow and poplar, and rise to where the pines and firs are waiting on the sky-line; we wind up and away from meadow and cornfield to where moss and heather crowd among the rocks; we strike into the colder mountain air, the bare and austere mountain world, away from trees and heavy flowers and chattering birds, to where only the bees and the larks make music, and where the little flowers, hardy and wild and fragrant, lodge among the sun-warmed rocks.

III

A day's journey on a motor-car is not merely a piece of travel across the spaces of geography; it is often a voyage through the life and history of the land. Perhaps you pass across the Weald of Surrey and Sussex, where once the forests were thick, where later the smoke rose from a thousand fires and the land was blackened with the industry of smelting; but where, in our own busy and clamorous age, the ashes of that forgotten toil are folded in the deep peace of fields and gardens. Or you may fare along the Roman roads—those ways made sacred by the passage of immemorial hosts, of conquering armies, of all the pedestrian life that in years gone by came to its twinkle of existence in our country and vanished like smoke. Or you may set forth of a morning from some great modern city humming with commerce and echoing to the strife of politics and exchange; and you may draw up as the sun sets in a little town perched above the sea, where the quays, deserted by commerce, resound to cries of the little barefoot children of sailors. Yet they are not ordinary children nor ordinary sailors that you will meet on this narrow street by the harbour, but fair-haired, blue-eyed babes showing beneath grime the strong features and bright eyes of the Dane; and tall, deep-chested, big-boned men, with the same childish eyes and tangled yellow hair—sons of Norsemen and Vikings, cast up in the dusk of their race on these neighbourly shores.

And wherever you pass on your journey the road tells you the story of the people who live beside it. To drive from London to Chester is to be instructed in the character of the great divisions of England. The rich sleepy life of the south

is traversed by the road that runs wide between the sunned and weathered houses of a dozen High Streets, sheltered by great and ancient trees, and skirting for miles the boundaries of many a vast feudal estate. You pass through the shires and the Midlands, where the world seems to consist only of fields and sky and trees, and where, lost amid this pastoral wilderness, you wonder what has become of overcrowded, town-devoured England. Yet a little while, and you are plunged in the grime of the Black Country, where the trees are stunted and the vegetation poisoned, and where the smoke of a hundred industries darkens the sky. Again a little while, and you are back in a smiling land and speeding on through a country that is subtly different from that of the earlier miles, where something in the build of the houses, in the disposal of the villages, and in the very faces of the inhabitants tells you that you are in the north. And in all your passage through this changing scene, in the glimpses you get through open doors of a family at dinner, a child at play, or a horse in his stable; in the attitude of women who stand at the doors shading their eyes to watch you go past, or in the sight of a tired labourer trudging homewards at sundown, you are reminded of the eternal difference in point of view between the traveller and the resident, between those who have their continuing city in the small world that represents but a moment in your impassioned journey, and those who, in their relation to that world, are only wayfarers and strangers.

IV

There is still here and there an opportunity of seeing the invasion of this new force upon virgin soil. In the early summer of 1904 I went to the Isle of Man to see the English Eliminating Trials for the Gordon Bennett Trophy. Three racing cars were to be chosen to represent their country in this international contest, and the eleven aspirants for that honour were matched against each other in a road race hardly less long and severe than the great contest itself. But interesting as the race was by virtue of its chances, its immense speed, and its almost incredible safety, it was not so interesting as this sudden descent of all the mechanical furies contained in a dozen racing cars upon a virgin island, girdled for ever by the unchanging

sea, folded as yet in its peaceful slumber of winter and spring, and not yet aroused to the unlovely commotion of tourist traffic. A dreadful interest, a profound mystery, overhung these machines in the contemplation of the populace. Lurking within their dens all day, for they were properly forbidden to scour the roads during waking hours, they aroused themselves at early dawn and awoke for a few hours of their terrible life. With the first of daylight they would come forth, trembling with restrained passions, emitting thick streams of explosions upon the quiet morning air. Their masked and swathed directors, sitting bolt upright on their frail seats, controlled with a turn of the wrist the forces that presently hurled them inland up the mountain road, leaving the few early risers in the market-place stupefied by the sudden silence.

And they were far from docile, these monsters ; far different from the obedient and responsive creatures that carry us on our country journeys. Each represented the last ounce of brute power that the builder dared to contain within a light and frail carriage. To drive one of them was no easy task, but a prolonged battle with the terrific demon that, only half tamed, raged within the cylinders. Some of them would not travel at all ; there was one ill-starred brood of three that had their lair in a shed upon the harbour wall, to whom all day and all night an army of foreign mechanics diligently ministered. At intervals their toil would reach a point at which the result might be tested ; the starting handle would be manned, and the monster waked into life at the cost of a dislocated wrist. Then a dread commotion indeed would echo among the rocks. A rattling crescendo of explosions, a blinding sheet of flame, with, at short intervals, a detonation like the report of a heavy cannon, would bring the townspeople of Douglas running to their doors. They would scan the horizon, as though to look for a bombarding fleet or a volcanic eruption of their silent mountains. But no ; a little group of workmen surrounding a low, slight, motionless machine mounted on low wheels were all the centre of this tremendous and elemental uproar. Now and then, indeed, labour would be so far rewarded that the chariot of fire might be run along the harbour wall, the fascinated crowd scattering before its swift and deafening progress ; but in a few hundred yards it would be pulled up, or else its giant

pulses would mysteriously die down. And all day long and everywhere the presence of these few cars brooded over the island like a doom. In the towns people crossed the streets quickly, with an eye over the shoulder for the delightful, thrilling terror that might at any moment (so they thought) rush out upon them; and up in the inland fields men strained their ears to hear, amid the whisper of the waving grasses, the increasing pulsation that might herald the lightning passage of that which bewildered the eyes and made the heart quake.

V

On one of the racing cars, by favour of its master and tamer, I took a cramped and precarious seat on a morning before the sun rose. The houses of Douglas lay blind and silent in the dawn; the gas lamps burned almost invisibly; and as we rushed along the promenade our echoing progress was through a city of diurnal sleep. There is about the dawn a solemnity and strangeness that no familiarity can change; but though I have seen its magic panorama from city streets, from the sea, from sub-tropical tablelands, in all sorts of places and conditions, it has never seemed to me so new and mysterious as on that morning in the Isle of Man. All round us the world seemed to lie asleep, the sea dull and grey and still under a soft muffled sky; only we seemed alive as, seated on our infernally potent machine, we clove the stillness and tore through the silence. In twenty minutes we covered nearly as many miles of the island road; now the sea was behind us, now it rose before us as, having spanned the breadth of the island, we hung over the little town of Peel; a little later we were at Ramsey, and could see England and Scotland and Ireland rising out of the morning mists. And there seemed to be but three conditions of our existence: the land, like the island of a dream, empty, deserted, silent; the slow and solemn scenery of the morning, unfolding itself on the world in a glory of fire and colour; and the weird creature of iron and steel that swayed and chattered and flew beneath us. The ineffable thrill and exhilaration of such a flight none but they who have experienced it in their own bodies can ever conceive. It is beyond everything else in our physical existence. It is the exaltation of the dreamer, the

drunkard, a thousand times purified and magnified. It is not mere speed, for that may be equalled on an express train without any like effect. It is, I think, a combination of intense speed with the sensation of the smallness, the lightness, the responsiveness of the thing that carries you, with the rushing of the atmosphere upon your body and of the earth upon your vision. The road, twisting and wriggling before you, streams endlessly under the wheel; the trees fall into advancing ranks; the very mountains, that in half a day's walk do not seem to change their places, move and wheel and curtsey round you in a stately dance. The tremendous detonations of the engine are silenced by the uproar of the air to a rhythmical beat, as the fires at its heart are cooled by the same pure stream; the road itself has a note, and every stone, telegraph post, and house that you pass close by makes a sharp sound, like the whizz of the Mariner's cross-bow. And to your exalted, expanded senses the noise of movement is heavenly music, the wind like wine of the gods.

VI

Once we stopped, drawing up by the fragrant roadside; and as the pulses of the engine died away, so died away the strange sensation of giant, divine life with which its breath had endowed us. No longer gods, we stood under a clump of hawthorn and gave ear to the first faint voices of the birds. Inert and dead reposed the magic carriage, all its fiery energy dissolved, helpless to move itself an inch, its devouring life resolved into a few hundredweights of metal, a few gallons of petrol, a few coils of wire, a few handfuls of salts and acids. In place of the rushing exhilaration of our stormy progress, the quietness of the morning now stole upon our senses. The road lay full in our view for a mile on either hand, empty. The great overture of the skies was nearly ended, and the eastern fires, now changed from saffron to gold, were gloriously revealed as the curtain of cloud rolled away. The sun began to warm the chilly air and, striking on our backs, threw our mile-long shadows on the road. And as we thus stood we were presently aware of a far-away throbbing sound that increased evenly from a drone to a weird cry—the sound of a racing car at full speed. A speck appeared over the edge of the distance, rapidly

grew and took form, and then in a flash one of our monster's rivals came up, went roaring by with its two crouching, wind-blown occupants, and was gone in a whirl of dust. The one glimpse we had of the driver showed a man with an adamant face, his hands clinging like steel to his steering wheel, his white overall flattened in front and distended behind by the wind. He came and went like an apparition. The moment after he had gone one could scarcely believe that he had been there, but his whirlwind passage left an impression that was at once startling, intoxicating, appalling. That is what it looked like—a shocking, death-challenging performance; and yet we who were familiar with it, who had but a moment before alighted from a similar flight, knew that the adamant face represented only concentration; that behind it there lay a brain perfectly cool, perfectly attentive; and that within the storm of noises and tempest of the nerves there existed a calm, an exalted, a serene contentment.

VII

And presently, while we still waited in the coolness of that early May morning listening to the birds that now began to sing more heartily, there fell on our ears another signal, this time of ominous portent. Far away among the fields of the lower valleys, like the firing of heavy guns, resounded the first of a series of echoing detonations. We looked at one another: "One of the Arrows," we said, naming the terrible but unlucky brood that had their habitation on the harbour wall. Herculean efforts, it appeared, had awakened one of these to the dread environment of the road, and it was even now on its way; but so fiery was its pent-up passion, so intemperate and greedy its frustrated appetite, that one out of every dozen or so of the inspirations of its lungs was gulped down raw, to explode in its bowels with a tremendous report. It must have been three miles away when we heard it first, for several minutes passed before the explosions, instantly increasing in volume, became so deafening as to assure us of the immediate arrival of the machine. Then it appeared, growing, like the insect of a nightmare, enormously bigger and louder; slowed down and drew up beside us; and, for once obedient to the will of its

driver, roared itself out into quietness. Then we were able to speak to the man and hear the tale of his journey. It was wild enough. He was covered, even to his face, with oil, which was flying up out of some neglected orifice; his frail seat had given way beneath him, and he was shaken and bounced precariously over the fatal chains and wheels of his charge; the covering of a metal switch controlling the passage of electric fluid to the vitals of the engine had come off; so that even to modify the speed of the insane projectile upon which he rode, he must instantly keep pressing his thumb upon the sharp and lacerating point of the switch, receiving an electric shock as well as a flesh-wound every time. "It isn't as if I had nothing else to do," he remarked, with singular moderation, as he wiped the oil and sweat from his face and the blood from his fingers; "but at any rate she goes!" And he turned again cheerfully to his really appalling task. The engine was restarted in a clap of thunder, and with a six-foot flash of yellow flame the car rushed away, booming like a minute-gun long after it was out of sight.

Insane and vulgar, you might be tempted to say of this unflattering portrait; but you would be very far wrong. The man was wrestling with a giant—"fighting his car," in his own vivid phrase; and he was fighting with a remorseless, a gigantic power. He was there to tame it, to bend it to his will, to conquer or be conquered by it. He was taking his part in the great breaking-in of this new force that will presently serve us universally and with complete docility—a thing, surely, a thousand times worth doing. He was one of the new race that has risen up for this formidable campaign, a giant in strength, a lion at heart, a good fellow in all human relations—in a word, a man entirely fitted to fight and wrestle with untamed machinery. Twenty years ago you would not have found men with the coolness, the nerve, the physical strength and brain endurance necessary to drive and steer along the country roads at seventy miles an hour an erratic and imperfect carriage; now they are with us in plenty, although it is rare to find them perfectly equipped. Such a one, I think, was he of the bloody hands and oily face; such a one is certainly my companion of that morning, beside whom, perched among the flimsy girders of his quaking machine, I sat as safely as in a garden while we took the

road again, climbing up the cold breast of Snaefell, chattering round corners and among the rocks of the mountain road, skimming again down the great spiral track, with the birds flying below us and the level floor of the sea rising up round about us. It is something more than a whim of mine to believe that a very definite human virtue resides in the ability to meet all these risks smiling, and to turn them into safety; and when we drew up at our journey's end that morning, and the intent angle of his broad back was relaxed, I knew that my friend had a good human heart.

VIII

Of the race itself, which differed little from other motor road-races that I have seen, we may pause to take one glimpse here. There is no form of sport that seems quite so inane to those who merely read about it as a motor road-race, with its confusion of circuits, its controls and neutralisations, its vexatious details of minutes and seconds. Yet for those who are present and who follow the fortunes of the competitors throughout their arduous day there is interest enough to keep the mind entertained and the imagination busy. For though perhaps only once in an hour and a half do the watchers at any one point catch a glimpse of each competitor, the intervals are full of expectation, of flying rumours, of winged fragments of news that travel in some mysterious and unknown way across the hills and valleys from lonely parts of the course. That a competitor should have suffered a punctured tyre or a broken chain twenty miles away will sometimes be known at controls where no telegraph wire is tapped, and whither no merely physical agency can have carried the news; and known at a moment impossibly soon for any normal means of communication. One accepts it all as a phenomenon of the quickened atmosphere in which these giant infants of the human brain live and move, the radiant energy, both of mind and body, that infects all who approach them.

Regard one single instance of its working. At a control established in some wayside village, that yesterday slumbered over its sunny and deliberate occupations and to-morrow will gratefully return to them, stands a little group of officials with their paraphernalia of papers, stop-watches, reports, and time-

sheets. The road, curving round into the village, is flanked by sightseers encamped for the day. On one side is a depôt for pneumatic tyres; on another a whole engineer's establishment from London or Birmingham, with its attendant army of mechanics. Only the road itself is empty, lying white and expectant in the sunshine, carefully guarded by barriers, ropes, constables. All the ordinary village sounds are stilled; the smithy lies cold and idle, the shops are shuttered, the rumbling farm carts are laid up in their sheds; there is no sound but—the strangest of all sounds to hear about an empty road—the low continuous buzz of talk. The papers on the official table flutter in the breeze; the officials, tired of comparing their vast array of figures, talk in desultory groups; the mechanics are stretched on the warm ground, resting; and thus the scene remains for a little while until the telephone bell tinkles, galvanising the official group into attention. The murmur of conversation swells for a moment as the name of the coming competitor is passed along; the dozing mechanics rouse themselves; the tyre repairers fall into an ordered readiness; and then the throng settles itself to silence for a moment. They are listening. Far away, nearer, nearer still, sounds a steady throb; a pillar of dust like the smoke from a field-gun rises from behind rising ground; and some seconds after, arriving like a giant projectile from the same gun, the long, low car rushes with a scream of brakes up to the line. In a moment sound and commotion surround it; it is enveloped in a cloud of officials and onlookers, smothering their voices in the uproar of its engine. The times are taken, the stop-watches set going, and it moves forward to the repairing station. The beast is maimed; it is thirsty; its begrimed directors, unable to make themselves heard above its defiant bellowings, gesticulate and point to the wounded part. Mechanics throw themselves on the ground beside it, crawl beneath it, lie with upturned faces close to where all the wild powers of fire and steel are rending its heart with shattering explosions. On its tyres, hot with all the hatred of the spurned miles, are thrown glittering cascades from a dozen pails of cold water; into its maw is poured gallon after gallon of fluent life, limpid as summer dews, dreadful as the caverns of Vesuvius; attendants minister to the needs of the driver and his assistant, who, seated on their reverberating

platform and well-nigh drowned beneath the deluges of water and petrol, receive indiscriminately sandwiches, champagne, apples, chicken, and concentrated foods. And all this deafening and passionate activity lasts only for a few seconds. As the last mechanics scramble from beneath it the mighty engine, now refreshed, grips the transmission shaft; the car bounds away; the stream of explosions fades in the distance; the crowd in the control returns to its quiet conversation; and only a dozen green petrol tins, a pool of water, a broken champagne bottle, a half-gnawed apple, a piece of sponge-cake soaked in wine and petrol, and a banana skin lying in a puddle of oil, mark the scene of this momentary and monstrous refreshment.

They see not the whole of this picture who regard it as a signal of vulgar and extravagant folly. Among the onlookers and the cloud of parasites that buzz like flies round the commercial honey of which each car is a centre, there are doubtless many dull, greedy, and partly insane persons; but never among those who work, whether they stand for ten hours in sun or rain at a wayside control toiling at advanced mathematics, or storm along at the extreme of speed for the same ten hours, or lie on their backs with the inventors in pools of oil, petrol running into their eyes, brute metal at a red heat menacing their faces. Ah, no; in the labours of these there is something Titanic, something of the dignity that invests all worthy battles fought against heavy odds, something of the fragrance of enthusiasm, the glory of the pioneer, the nobility that crowns all those who work for to-morrow. For among them they are discovering, moulding, teaching, adapting, and tempering what we may call the character of the motor-car—a profound and singular personality, full of life and power.

IX

But we have perhaps pored too closely over the wheels and cranks of the machines themselves, and delayed too long our return to the open road; and in doing so we have but fallen into the common fault of forgetting, in contemplating the means, the end for which our fascinating slave was called into being. But once on the road it ceases to be a mechanical study and becomes part of ourselves—an executive part that answers

our will and carries us whither we would go. And there is its proper place, that is its proper mission, apart from which it can only be imperfectly understood. A ship lying upon the foul waters of a dock, unmoved by the tides, unvisited by the sea breezes, is often but a sordid thing, dark and stuffy and evil-smelling. But see the same ship when she is in her own place, when the blue seas heave under her, and the trade winds hum in her rigging. How pure she is then, how properly adapted for her purpose; how the sunlight searches all her corners, and the salt airs make fragrant all her spaces! So with the motor-car; if you would appreciate it, you must take it to the open road; and really to know all its virtues you must drive it yourself, become one with it, establish between it and yourself that sympathy which is perhaps the most enchanting of its qualities, and is really the secret of effortless control and mastery.

At first the road will alarm you by its panorama of risks and escapes; then it will exhaust you with its unending claims upon your attention and interest, so that at the end of a day your mind will refuse to desist, and will go on directing your progress; and, finally, it will hypnotise you and implant in you that restlessness, as haunting as the *heimweh* that is its opposite, with which it draws back to itself all who have ever fallen under its sway. This passion for the road is a far from new thing—it is one of the oldest things in the world. But it is new in its intensity; and I can imagine, when the first generation of motorists shall have passed away, their spirits haunting for ever the highways that first enthralled them, and ghostly puffs of dust travelling by themselves throughout a long summer's day, and the wind of an unseen passage fluttering the heaps of autumn leaves by the wayside. And so I doubt not that when some of us who have fallen into this bondage lie a-dying, the last image of the world present to our minds will be the picture that thousands of miles have photographed on our memory; of the road stretched white and narrowing, of the trees hurrying to meet us, of the snug homesteads left behind in the dusk, of the eternal Unknown that lies just beyond the turn of the road.

X

Of all the roads that ribbon England none is more alive, or has a more engaging personality, or expresses more clearly the spirit of the road, than Telford's great highway from London to Holyhead. Made for endurance, it has long outlasted its first purpose, until in the fulness of time that purpose has been restored to it, and once more it is in use from end to end. No longer a mere chain of short links connecting hamlet with town, and village with city, it has come again, by wonderful revolutions, to its ancient dignity. Modern ingenuity has breathed on its slumbering spirit, which in these latter days has waked again to the bustle of life, the song of wheels, and the great business of travel.

So many roads set out bravely enough and lose themselves in a tangle of crossways and bypaths, all their purpose dissipated, all their promise unfulfilled. But this is a road that sets out and arrives. Even while it is still within the influence of London its purpose is obvious to the traveller. Or rather, it is obvious that it has a purpose; a profound and determined, and yet a mysterious, purpose, as of one who should say: "I have set out upon a long journey; follow my guidance to the end and you will see what my purpose is." Even in these early stages, when its milestones bear such a legend as "Potterspury, 2 miles," the noble breadth and long straight bearings give the lie to an inscription so local and so petty. Obviously it has no concern with Potterspury. It does not go to Potterspury; it passes through it. Its purpose is serious and ultimate; but not until you have followed its every mile and the road stops on the edge of a sheet of green harbour water do you realise what that purpose was—why the road ran so straight through Daventry, why it did not mind going through Birmingham, or being soiled by the dust of the Black Country. For even when it was at Stony Stratford, it was the Holyhead Road, the road to Ireland. In its most dallying moments, looping round some pretty tree-clad hill or dipping into a valley sweet with sheltered flowers, it still meant to arrive; the dalliance was only momentary, only apparent; the ultimate purpose continually present and manifest. I speak as if the road moved and not the wayfarer; and perhaps the accurate man will quarrel with my

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paradox. Nevertheless it is one of the simple truths which accuracy is most apt to miss. In all our talk of roads this movement is taken for granted; all our verbs are active. The road comes from this place; it leads to that; it is a fast road or a slow road; it climbs hills, drops into valleys, crosses rivers, runs beside railways; and in all this speech its rippling, moving habit is illustrated. It is the road that really moves forward; at most the traveller follows it, lagging ever behind. For he never overtakes the road; it is always before him, just round the next corner, wriggling away like a snake from his pursuing wheels, always cheating, always beckoning, always eluding him, always going on.

The spirit of Telford, the man who dealt with flints and granite, hills and valleys, fields and rivers, and turned them all into miles, resides in his Holyhead Road. So much of honest labour does not die, but takes in the passage of years a character and personality of its own. One is tempted to moralise about the travellers upon the road; all the toiling feet, all the dusty wheels, all the hearts, sad and happy, that have passed that way and made sacred its ancient stages. The Romans in their day of pride; the armies, victorious and fugitive; the jolly-hearted travellers by coach in winter; the lovers trembling through the scented starlight of a May night—these all used the road, but are vanished out of its life and memory and have left not a scratch on the surface. It is no monument of theirs; it is a monument only to those who made it, breaking new ground here, taking in a length of time-worn highway there; surely a monument most stable and enduring. For all time—or so it seems to creatures of a day—its mark is set across the face of our island, recording, like a finger-post, one of the ant-like trails of human activity. Its daily history is an epitome of human life, for on its stage are daily performed all the acts in our brief comedy; daily it bears the physician to the bed of birth, daily the bridegroom hastens along it to meet his bride, daily it sees some hopeful heart set forth on his life's adventure, and daily its dust is stirred by the tramp and shuffle of feet moving to an open grave. All through the night, while we are snug in bed, its surface lies silent in the moonlight or glistening rain; but throughout the longer night, when we shall be no more interested, it will remain the scene of primitive

effort and joy and grief, and resound still to the rumour of labour and of life.

XI

Secure in its purpose, the Holyhead Road can afford to take on the colour of its surroundings. When it is in Dunstable it does as Dunstable does, spreading itself out as though land were of no value, and as though sunshine and a reposeful expansiveness were all that a road could desire. But it wears a different face far away in bleak Anglesey, where its miles are laid as a thread over stony moorlands; or where it cuts through the living rock, or spans the clear green waters of a sea strait. Strong in the sense that it is a national and not a local road, it speaks different languages in the course of its varied career. It can be as modern as Birmingham and as ancient as Pentre Voelas; it can be as dignified as Dunstable and as mean as Weedon; it can be as terse as Chirk or as redundant as Llanfairpwllgwyngyllgogerchwyrndrobwlltysiliogogogoch. And safe in the knowledge that it is the Holyhead Road, it does not observe a timid exclusiveness, but now and again shares a stage with other roads of suitable dignity. Here it borrows a mile or two from its great brother, the North Road, there keeps company with its Roman ancestors, Watling Street and the Old Chester Road. It is at once catholic and distinguished, generous and thrifty, cheerful and serious. Of the lesser highways that come to salute its glorious progress all are made welcome, whether as tributaries or borrowers; roads that come rushing pell-mell into it down a steep hill, roads that sweep grandly away from it and end foolishly in a cattle-yard, roads that steal away for an almost parallel hundred yards, and then suddenly and hastily turn off at right angles. Great and small, broad and narrow, they are all admitted to its company, with one single and significant exception—the shining steel way that once robbed it of its glories and left it for years lonely and deserted. From contact with this despoiler it now keeps itself inviolate. There are no level crossings on the Holyhead Road; the railway may soar above it or burrow beneath it, but may never again meet it on the level.

XII

If, winged with the modern magic, you use the Holyhead Road you cannot fail to be cheered by a great company that keeps with you throughout the miles. I speak not of the trees, but of those more constant flankers of a main road, the telegraph posts and wires. You first become impressed by the majesty of their companionship as the road leaves St. Albans. Before that, if you approach the Holyhead Road as I love to approach it, by the winding, hill-tossed way from Edgware through Elstree, you will have noticed a single rank of wires here and there hurrying to the great tryst; and as you pass through the streets of St. Albans they begin to crowd together, by twos and fours, coming, you would think, from nowhere, flying in all directions over the ancient roofs of the town and past the chimneys and weather-vanes like gathering rumours, or like flurried passengers making haste to be in time. And then, as you turn the corner out of the town, you come upon the first of those mighty twin posts, braced and stayed against the pull of eighty wires humming steady organ harmonies in the wind, upon which all the convergent threads of news are ranked for their northward march. Oh, but they are brave companions, singing their song in the breeze, pointing the way far ahead up the mountain road, and for ever ranking and drooping and streaming, and starting up and swooping down beside you! Once, near Bangor, you lose them for several miles, and cannot see them on either horizon; but suddenly they rush upon you again from behind a hill, as though they joyed in the reunion after pursuing some short and steep cut of their own. And fast as you fly, the messages of good or evil news, of fortunes won or lost, of lives begun and lives ended, are flying faster along the wires; and far as you follow the road's course, they are diminishing in number, dropping off to finish their journey (so grandly begun) at some wayside village. For of all the company that marched through Dunstable in double ranks on each side of the road, four posts abreast and forty wires to a post, only two keep faith with the road. These are the two that, when the last miles have been entered and the journey has resolved itself into a dream of miles and speed and a wind laden with honey and roses, go with you down the long straight ribbon over Anglesey

to where the sea plunges under the cliff and the gulls cry about the lighthouse. For the wires are the Holyhead wires, although you could not distinguish them among the throng at St. Albans; and the wires dip under the sea and go on to their promised land; but the road?—The road to Ireland, for all its earnestness and splendid purpose, pauses for ever on the edge of Wales, and resigns its charge to the waiting ships. . . .

In a play by Mr. Yeats a dreamer says: "The roads are the only things that are endless." To which a matter-of-fact person, unconsciously expressing a still greater dream, replies: "Yes, but even they have to stop when they come to the sea."

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